Transportation problems in the city of Makkah outside the period of Hajj.

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Transportation Problems in the City of Makkah
Outside the Period of Hajj

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To my beloved family: Father, Mother

and wife.

ABSTRACT

Makkah is an ancient centre, with a history extending back to 1892 BC. Makkah has been and remains uniquely important as the heart of the Islamic world, being the birthplace of the Prophet Mohammad and of the origins of Islam. It is the focal point for Moslems the world over, and, in addition to the many visitors throughout the year, the city receives a huge annual influx of pilgrims during the period of Hajj. These factors place transportation in Makkah under heavy pressure.

The creation of the Kingdom of Saudi Arabia in 1932, and the discovery and exploitation of oil in the 1940s, have brought changes to the national economy. This has contributed to the rapid increase in urbanisation in the country, and particularly in Makkah, which has changed dramatically. The new source of wealth has had a marked impact on Makkah. The city has grown rapidly in population and physical area, and therefore transportation needs. The sharp increase in car ownership and use have brought many social benefits to Makkah, but has also created serious transportation problems similar to the problems experienced by many other cities in the world. The purpose of this study is to investigate, from the geographer's viewpoint, the problems of urban transportation in Makkah outside the period of Hajj.

The thesis is divided into eight main Chapters (excluding the Introduction and Conclusion). Chapter 1 considers the physical and historical geography of Makkah, showing how the city grew, and the reasons why the road system, being the product of the era before motor vehicles, was largely unsuited to the needs of the modern age. Chapter 2 continues this theme, showing that the increase in the number of motor vehicles in Makkah has made further road improvements essential. Chapter 3 shows the significant ways in which different modern methods of transportation affect population mobility. The intention is to establish whether or not private car ownership affects the role of public transport in the city, and to what extent the increase in the number of private cars has accelerated the decline in the level of public transport services. Chapter 4 discusses the role of public transport in the city. Chapter 5 examines specific problems resulting from the rapid increase in the number of private vehicles on the city's roads, namely traffic congestion and unpleasant environmental conditions (such as noise, air pollution) and road traffic accidents. Chapters 6, 7 and 8 show different aspects of the effects of the rapid increase in the number of private vehicles and the expansion of the city. These aspects include access to major institutions and buildings, and the effects of land use, topography and weather on the behaviour of people using car parking facilities. These Chapters, through examination of evidence from intensive study of key locations in the city, discuss the adequacy of car parking facilities in Makkah.

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GLOSSARY

1 Qibla: Direction to which Muslims turn in prayer (towards the Kaaba)

2 Kaaba: The holy house of Allah.

3 Hajj: Pilgrimage to Makkah.

4 Zu'lhijjah: the last month of the Islamic calendar, and in which the Hajj ceremonies are held.

5 Haji: Pilgrim.

6 Moharam: The first month of the Islamic calendar.

7 Ramadan: The month for fasting.

8 Shawal: The tenth month of the Islamic calendar. The first day of Shawal is known as Id-al-Fitre, that is, the Feast of the Breaking of the Ramadan Fast.

9 Jummah Prayer: Friday Prayer.

10 Weekend: Thursday and Friday.

11 Weekdays: Saturday through to Wednesday.

12 Kaliph: The Successor of the Prophet Mohammad.

13 S.R.: Saudi Riyal, the unit of currency in Saudi Arabia.

14 Suq: Market.

15 Bab: Gate.

INTRODUCTION

0.1 Introduction

The city of Makkah is an ancient centre with a history extending back to 1892BC (1). Makkah has been and remains uniquely important for several reasons. First, the city is the heart of the Islamic world, containing the Holy Mosque (Al-Haram) and the Kaaba (the holy house of Allah) at its centre which every Muslim must face during prayers five times a day. Secondly, it is the birth place of the Prophet Mohammed and the origins of the religion of Islam are to be found here. Thirdly, because the city is the focal point for Muslims all over the world, the city receives a huge annual influx of pilgrims at the time of the Hajj, and many other visitors throughout the year. These factors put the city under heavy pressure from the point of view of transportation. Similar situations occur in Al-Madina, the second-greatest city of Islam, where there is the Prophet Mohammed's tomb and the famous Mosque (2).

Until about the end of the nineteenth century, Makkah maintained its traditional, magnificent character. However, since the creation of the Kingdom of Saudi Arabia in 1932, the city has changed dramatically. Changes have been particularly rapid in Saudi Arabia since the discovery and exploitation of oil in the 1940s. The changes which oil brought to the national economy have contributed to the rapid increase in urbanisation. The city of Makkah has thus felt the impact, particularly in terms of urban growth, of changes experienced by a new nation-state, as well as those due to new wealth created by oil. The new source of wealth, and its marked impact on the city of Makkah, has resulted in rapid growth in transportation associated with a rising population and increasing car ownership and use. The increase in the number of vehicles has brought many social benefits to Makkah, but has also created serious transportation problems similar to those of many other cities in the world. The basic purpose of this study is to investigate these urban transportation patterns and problems during the non-Hajj period.

0.1.1 Previous Studies

There is an immense quantity of literature about the long history of Makkah extending from the time of the Prophet Abraham to the present day. The oldest historical books include some information about developments of the city road network and the frequency of flood hazards, but in general there is relatively little data on transport and communication. Some useful historical detail was found in Arabic classics, notably Akhbar Makkah by Al-Azraki (250 AH, 829 AD), Shifa'a Al-Garam Bi-Akhbar Al-Balad Al-Haram by Al-Fasi (775 AH, 1354 AD). More recent historical sources of value were The History of Makkah by Al-Sibai (1380 AH, 1959 AD), Al-Tarikh Al-Quaim Li-Makkah Wa-Bait Allah Al-Kareem by Taher Al-Kurdy (1385 AH, 1965 AD), Miraat Al-Haramiin by Ibrahim Riffat Basha (1318 AH, 1901 AD), and Al-Batanoni's book Al-Rihala Al-Hejaziah (1327 AH, 1906 AD). Moreover, the city also received attention from Western travellers, especially J.L. Burckhardt who described the city of Makkah and the pilgrimage during his visit in 1230 AH (1814 AD). A comprehensive bibliography of historical and other works consulted in the preparation of this study is included in this thesis. The language of works not in English has been stated, but the titles of some references have not been translated for fear of introducing ambiguities.

In recent years, much research and study has been focussed on pilgrims and pilgrim accommodation in Makkah because of the problem associated with the Hajj. One of the leading researchers on this topic was Dr. Khazy Makky (1976). There has also been a major focus on the urban planning aspects and social and economic issues; Dr. Khalid Al-Ankery (1979) and Dr. Hasan Ilam in 1979 dealt with such topics. In addition, M.R. Mirza studied the impact of selected physical factors on settlement development in Makkah (1979) and Dr. Al-Sanii studied the health services in Makkah (1982). Other research has concentrated on the problems which pilgrims face and the services and facilities they need. Such a study is <u>Pilgrim Food Survey</u> (1400 AH, 1980 AD) conducted by the Hajj Research Centre. The Hajj Research Centre extended its study on <u>Pilgrims Using Services of Matawaf</u> (1400AH, 1980AD). A comprehensive study for Mina area was also conducted by the Centre (1400AH, 1980AD). In addition, housing is a particularly important theme, as shown by the work of Majdi M. Hariri (1986) who studied the influence of Hajj on housing in central Makkah. The author is much indebted to these works but it should be noted that little academic research has been focussed upon the non-Hajj period.

Official publications were a source of much vital data and background information. The Ministry of Interior, Municipal Affairs, Regional and Town Planning Department, set out overall objectives for city development in Saudi Arabia in the first (five year) Development Plan (1390AH, 1975AD). These objectives were:

(a) to promote regional development in the Kingdom;

(b) to provide reliable essential services (water, energy, communications);

(c) to ensure an equitable distribution of social services, and

(d) to maximise the return on investment in development projects.

In order to achieve these objectives, at the beginning of the 1970s the British firm Robert Matthew, Johnson-Marshall and Partners was invited to make a comprehensive study of the Western Region and to prepare the first Master Plan concerning the cities of Makkah, Medina, Jeddah, Taif, Yanbu and Tabuk. In preparing the first Master Plans they followed the national objectives as set out above. Robert Matthew, Johnson-Marshall also sought to meet thirteen key objectives in the proposals to develop cities in the Western Region. Two of these objectives were: (i) to provide an adequate road network in the city of Makkah as well as its region, and (ii) to encourage the development of appropriate public transport systems in order to assist in achieving a balanced choice between private and public transport [3]. In order to construct a public transport system, Robert Matthew, Johnson-Marshall recommended that detailed specialist studies would be required to investigate the most appropriate system. Therefore, the Saudi Ministry of Transportation commissioned further public transport studies to help achieve a balanced choice between public and private transport. In 1976 the Ministry of Transportation agreed with Jamieson Mackay and Partners (Consulting Civil and Transportation Engineers) to carry out the urban public transport studies for the city of Jeddah and the Holy cities of Makkah and Medina in three phases:-

(i) Phase 1 Planning and feasibility studies

(ii) Phase II Final designs of construction of terminals and depots

(iii) Phase III Supervision of construction of terminals and depots

The consultants recommended that public transport services should be designed to achieve three objectives, which are:-

(i) Maximum convenience for passengers by having services routed close to their origins and destinations:

(ii) Operational efficiency by matching the capacity of the system to the levels of passenger demand throughout each sector of the city and

(iii) Low fares policy in order to encourage the use of public transport [4].

Although the consultants were commissioned over a decade ago there is no trace of any official evolution of the objectives of Jamieson-Mackay and Partners, such as the suitability of public transport services, the location of terminals for passenger movement, the efficiency of the existing public transport system, or the level of fares. In addition no study was found to indicate what has been achieved from proposals made by Robert Matthew, Johnson and Marshall to create an adequate road network to relieve congestion and meet transport demand. Such a study should evaluate the suitability of the city road network as the city has grown and car ownership rapidly increased, associated with high income level.

Most existing studies of transportation in Makkah have concentrated on the Hajj period when the city experiences a huge annual influx of pilgrims (about 2.5 million) which generates extremely heavy use of the city road network creating delay and congestion. The regional and urban transport problems during the period of Hajj are particularly severe as a result of a number of factors:

(1) Pilgrims arriving by air and sea at the city of Jeddah as well as the sea port of Yanbu city on the Red Sea must be provided with adequate transportation to the Holy cities of Makkah and Al-Medina;

(2) Once they arrive in Makkah, adequate accommodation must be ready for them;

(3) The main purpose of pilgrims during the Hajj is to fulfill the religious ceremonies of going to Al-Haram and the other Holy Sites of Makkah (Arafat, Muzdalifah, Mina). Thus, there must be adequate transportation between their accommodation and the Holy Sites of Makkah on specific days and at specific times;

(4) Most pilgrims come to Al-Haram either by using public transport or on foot. This creates conflict between vehicles and pedestrians which causes delay and congestion when approaching the Al-Haram area;

(5) Large numbers of buses are used to transport pilgrims between the city and the Holy Sites. These buses create congestion by parking on streets to pick up pilgrims which reduces the road capacity to a very critical level.

Because of these five specific difficulties during the Hajj there has been great emphasis on improving traffic flow during that time by adopting high technological engineering solutions such as creating flyovers, tunnels under roads and introducing one-way systems and the like. In addition to these solutions, small cars are restricted from entering the city and being used on city streets during the Hajj. Kerbside parking is restricted in certain areas such as Al-Haram and districts that largely accommodate pilgrims. This is to make pilgrims' transport much easier and faster than in the past in order to enable pilgrims to fulfill the pilgrimage religious ceremony comfortably and safely. In contrast, transportation problems outside the period of Hajj have been neglected. For much of the year the city is as any other city: the normal transport problems of every city in the Kingdom and every large Middle Eastern city occur in Makkah. For instance, in the case of Cairo:

> The dramatic increase in the number of private cars in Cairo (about 40% increase between 1976 and 1978) significantly contributes to the problems of congestion, safety and pollution (both air and noise) in Cairo.

Also:

> Like most cities of its size, Cairo faces important questions concerning the future role of parking facilities and policies (5).

In South-East Asia:

> Singapore has created major problems in accommodating the motor vehicle. Increase in car ownership is often associated with increase in wealth even if only for the prestige it brings. Unfortunately the density of population and the road network in Singapore are not suited to dense traffic, and measures have had to be introduced to limit the number of cars in the city (6).

In Baghdad:

> The high population number and the continuous population growth lead the city to face difficulties. One of these difficulties is the transportation problems brought about by the high income level and the high car ownership (706,000 in 1985) and its heavy use. The heavy use of motor vehicles in the city brings problems such as congestion which leads to much delay and increase in road traffic accidents. In addition to that on-street parking, the shortage of parking facilities both with the high traffic volume entering the city centre aggravate the city transport problems (7).

0.2 Aim of the Research

The aim of the research is to investigate urban transport problems from a geographical point of view, in the city of Makkah outside the period of Hajj. The study of transport problems, as in any other big city, is concerned with traffic flow, car parking, road traffic accidents, access to key institutions and buildings and the environmental problems associated with heavy traffic, such as air pollution, noise and damage to buildings. These problems have become a major headache for the city of Makkah in spite of its modern road network with wide roads, highly sophisticated tunnels, bridges and ring roads. Many of the most acute transport problems are evident at the local level in the city, and occur regardless of the time of year.

This research attempts to find answers to the following questions:

1 How far do natural topographical features, inhibit the development of the city road transport network?

2 Does the land-use pattern, much of it inherited from the past, also affect the development of the city transport network?

3 How far is the city road network able to cope with the advent of new methods of transportation?

4 What are the chief reasons for trip generation in modern Makkah?

5 Are the public bus services adequate outside the period of Hajj?

6 Are car parking facilities adequate at the major activity centres (e.g. Haram area, hospitals, schools, university, government offices, shopping areas and industries)?.

7 What are the environmental effects of the motor vehicles and are they spatially concentrated?

In answering the first, second and third questions, a geographical and historical descriptive approach was adopted. To answer the fourth question statistical data and direct observation were required to understand the purpose of each individual trip and how the trip was accomplished. To answer the fifth, sixth and seventh questions, further statistical data and direct field observation were needed to obtain a clear picture of the effect of car ownership either positively or negatively on public transport facilities and services and the degree of demand on parking facilities.

0.3 The Significance of the Study

The study is important because the major transportation problems in the city of Makkah outside the period of Hajj have been comparatively neglected. The problems are deeply complex at the present time and will probably increase to critical levels in the future as population and car ownership increase. There is every sign that the number of trips will increase while transport methods and systems which have created the present problem are likely to persist. The negative consequences that the city faces such as delay, road accidents, noise, air pollution and high demand on parking facilities will be exacerbated if solutions are not implemented. These transport problems outside the period of Hajj can be attributed to a group of factors as in any normal city. They are worth a brief summary as follows:-

1 Even outside the period of Hajj the religious function of the city draws large numbers of visitors every day and night. This keeps the city road network busy at most times with visitors' vehicles. During the Hajj the entry of small private vehicles is restricted, but at other times visitors may enter the city by car.

2 Besides its religious function, Makkah functions as a normal city with significant functions, nationally and regionally as the administrative centre for Makkah region. Meanwhile, the city significantly functions as the educational, health, social, economic and commercial centre not only for its permanent population, but also for its region and for the visitors who come to the city throughout the year. It should be noted that Makkah (with a population of over 600,000) is the third most populous city of Saudi Arabia after Riyadah (1,000,000) and Jeddah (900,000).

3 Because of its religious significance, Makkah is connected with other cities in the Kingdom by modern highways, thus making it a signifioant regional transportational node. The high daily traffic flow which passes through the city (e.g. to Al-Medina north of Makkah) aggravates transport problems.

4 The city has grown rapidly over the last two decades. This is due to the unlimited financial contributions made available by the Saudi government to Saudi citizens through the Real Estate Development Bank (REDB). This bank effectively gives Saudi citizens in the city loans free of tax and interest with which to build their own homes. From 1975, when the bank started, to 1984, the bank gave 12,414 loans, and one loan represents one house [(8)]. The city is now a large and sophisticated metropolis. Predictably, Makkah today has several features common to many large western urban centres, five of which are worth mentioning:

a a great number of secondary and minor roads, the functions of which are defined by a complex land-use pattern and very complex relief aspects, a situation similar to the city of Constantine in Algeria [(9)];

b modern engineering solutions to traffic problems, e.g. a number of tunnels and ring-roads which facilitate access to the city centre;

c a number of fringe residential districts far from the city centre which are rather difficult to provide with adequate public transport services. Many of these districts lack services and amenities of their own, thus generating trips towards various centres within the city;

d a high percentage of the population of Makkah enjoys a large income, and therefore private car ownership is widespread. The high level of car ownership can be considered one of the chief factors causing congested roads in the city. In a similar way, in Kuwait, the rapid increase of motor vehicle ownership is considered the major cause of transport problems [10];

e because of the location of Makkah's built-up area: in the main valley, bounded by mountains, pedestrian activity is not easy. This increases the distances travelled. Even roads accessible to pedestrians make extensive detours round the narrow winding streets. Similar occurrences can be found in Constantine in Algeria [11].

0.3.1 Conceptual Framework of the Study

The framework for the research in this thesis is outlined in Figure 0.1. This framework attempts to portray a theoretical approach to the study of Makkah's transportation problems outside the period of Hajj by developing the discussion of factors contributing to the creation of transport problems. The factors shown in the framework are concerned with the city's function, and includes the historical and physical geography of the city, taking into account the city population and the physical expansion of the city in connection with oil revenues, high income, increased car ownership and increased car use. The framework also examines solutions aimed at relieving the problems. It is the writer's belief that this information is

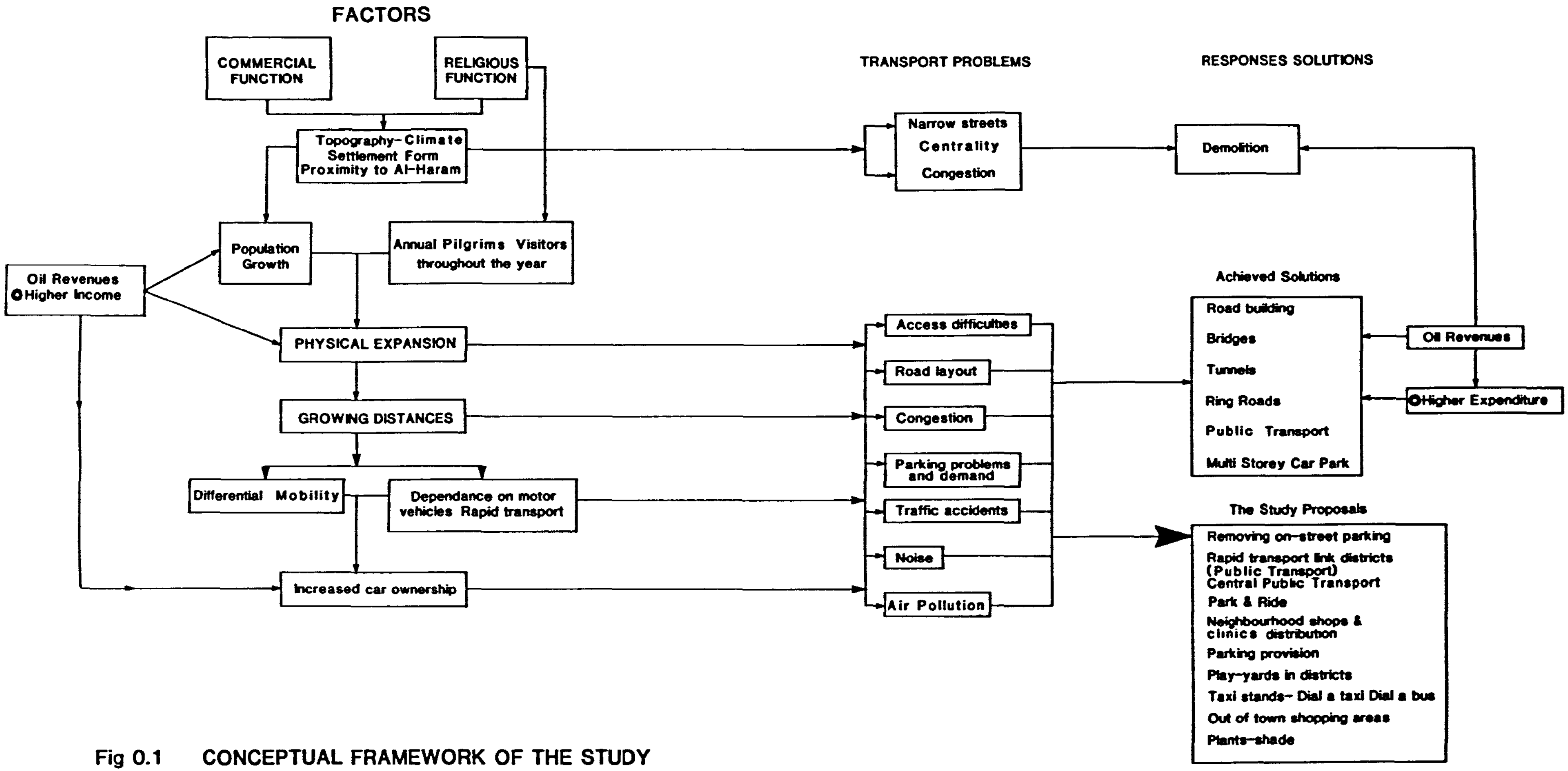

Fig 0.1 CONCEPTUAL FRAMEWORK OF THE STUDY

essential before discussion concerned with solving Makkah's transportation problems can be addressed. Extensive fieldwork was undertaken in Makkah to obtain data on these problems in 1984, 1985, 1986 and 1987. This data forms the basis of the research recommendations (Chapters 3, 4, 5, 6, 7 and 8), the latter also taking into account the responses and solutions of the city authorities. What has already been achieved, and what should be done in future is examined in the light of international experience in the field of urban transportation problems.

The author identified this piece of research, but clearly one researcher could not write a complete study of all the transport problems to be found in a large city such a Makkah. Therefore, in this research, it was decided to concentrate on particular aspects amenable to one man researching alone for three years. Aspects were sought which lend themselves to geographical treatment. The study is to do with the use of space, the availability of space for parking, access for people to key institutions, the relationship of the city centre with traffic flow, the relationship of important centres in the city with the transport network, causes and purposes of making journeys in the city, and the impact of motor vehicle use both on the environment of the city and on the people in connection with their spatial distribution.

0.4 Research Methods

Following some weeks of preliminary consultation in the Department of Geography, University of Durham, in January 1984, a research strategy was devised to ensure completion within four years. Because the author was seriously ill between August 1984 and January 1985, the timetable has been delayed. The research also proved to be extremely difficult.

Data collection was based on library searches, interviews with relevant officials, and above all personal fieldwork.

Library searches were conducted widely to discover historical sources on the evolution of Makkah and its transport system (Chapters 1 and 2). Most helpful were the Department of Geography library, Umm Al-Qura University, Makkah; the Department of Geography library, Department of Oriental Studies library, the Documentation Unit at the Centre for Middle East and Islamic Studies and the main University library, all at the University of Durham.

A computer search was made in the King Abdulaziz City for Science and Technology in Riyadh, to collect as much relevant material on the study area as possible.

Interviews were held with many relevant officials and experts in Makkah and Riyadh, notably:

- Hajj Research Centre, Jeddah and Makkah;
- the City Municipality and the Traffic Police Department, Makkah;

- Public Transport headquarters in Riyadh, and their office in Makkah;
- Ministry of Interior, the Public Security General Department (PSGD) of Traffic, Riyadh;
- Ministry of Transport, Department of Transport Branch, Jeddah;
- Deputy at the Ministry of Town Planning, Riyadh;
- Ministry of Planning, Riyadh and Jeddah offices;
- Ministry of Defence and Aviation General Directorate of Meteorology, Makkah Station;
- Ministry of Information, Jeddah and Makkah offices;
- Watson, Saudi Arabia Consulting Civil Engineers, Consultants to the Ministry of Municipal and Rural Affairs, at their office for storm-water system and drainage, Makkah.

Interviews were also held with numerous city dwellers and vehicle drivers in Makkah.

Because of the obvious limitations of available data, however, extensive fieldwork was necessary. In addition to the collection of further documentation, the fieldwork involved the design of several questionnaires (copies of which appear in Appendices A, B, C, D, F and G) were distributed in samples throughout the population of Makkah. These questionnaires were concerned with the following:

- car ownership and origin/destination survey (see Chapter 3);
- the public transportation survey and data review (see Chapter 4);

- parking studies (Al-Haram area - hospitals, shopping areas government offices, and the residential areas) (see Chapters 6, 7 and 8).

The research also involved intensive fieldwork counting parked cars on city streets (see Chapters 7 and 8), measuring air and noise pollution levels, and reviewing road accident data (see Chapter 5).

From June 1984 to the end of August 1984 survey interviews were conducted with authorities

- in the city Municipality;
- in the Public Transport Office;
- with some of the city dwellers.

The purpose of these interviews was to understand the transportation problems of the city. The contributions of people interviewed appears at appropriate places in the text.

Methods of distributing questionnaires in 1985 were standardised so as to achieve uniformity between the different types of survey. The following methods were used:

1 The writer personally conducted the fieldwork between 20 February 1985 and 20 July 1985.

2 Interviews for longer surveys were mainly conducted by students from the Department of Geography, Umm Al-Qura University, who were resident in Makkah. Their knowledge and first-hand experience of the city districts and local behaviour was invaluable.

3 Survey field sheets were printed in both Arabic and English to facilitate responses from non-Arabic speaking people.

4 Identity cards, bearing the photograph of the researcher, were held.

5 Permission was received from Makkah Province Office (Emarrat Makkah office) to conduct the research and encourage residents to help in answering questionnaires.

In May and June 1986, the writer conducted fieldwork to measure traffic noise levels in the city by using an XER-430-V Sound Level Indicator machine, obtained from the Department of Geography, University of Durham.

In May and June 1987, the writer conducted another period of fieldwork, comprising two elements:

a questionnaire distribution, for which see Appendix G;

b the measurement of atmospheric levels of carbon monoxide from automobile exhausts, using a manually operated Co 2000 Carbon Monoxide indicator, obtained from the Safety Department, University of Durham.

Data collected in the field were programmed for computer analysis to give a clearer picture of transport problems in the city. Computer Centre facilities at Umm Al-Quram University and at the University of Durham were used. SPSS and SPSSX programs were used to run statistical analyses, and GIMMS program was used to produce graphics.

The results of each survey are to be found in Chapters 3, 4, 5, 6, 7 and 8. Although much of the statistical information used in this study, collected from government institutions, does not extend beyond 1985, in some cases, where available, more up-to-date information has been included.

Colour photographs, although costly, were taken extensively in order to support statements which might otherwise seem exaggerated or even fictitious.

Both qualitative and quantitative methods were used to analyse statistically transport problems in the city. Two techniques proved useful:

a normal frequency distribution (numerical and linear);

b the Pearson Correlation Coefficient, required to examine the relationship between two variables (dependent and independent).

These two techniques are used in Chapter 3 through to Chapter 8.

Theoretical and mathematical models were not much used for several reasons. First, a full application of international models of trip generation, trip attraction and production, as in land-use transportation surveys, would have required heavy expenditure over a long period, and was clearly beyond the means of the researcher. The present work does, however, present a general picture of traffic movement from 44 samples in each of the 27 zones with a population greater than 20,000, collected personally in 1985, 1986 and 1987 during the limited time of summer vacation visits.

Second, the study is primarily concerned with transport problems at destination, and demands of people on the transportation system and the facilities they require, rather than with the dynamics of trip generation as such. In practical terms, data such as the number of dwelling units and households in each zone of the study area, the number of persons or employees, and income levels, are unobtainable in an interview situation and unavailable from official sources. To use mathematical models effectively, these data would need to be available. Arguably, the transport problems of the city are clear enough without the use of a model. Indeed, present models could well be inappropriate. For instance, had the gravity model (which is widely used) been adopted, it is unlikely that this model could take into account activity generated by the religious life and purpose of the city, nor its cultural importance in Saudi Arabia. The religious function of the city affects movement throughout the day, the flow towards Al-Haram occurring five times each day with some variation in volume, the nature of which is not known. Neither would a conventional model easily take into account traffic flow being greater at night in Ramadan (the month of fasting) and during the Hajj. To be useful, the gravity model would need modification.

The author, in exploring the literature on parking, has found that parking problems are treated empirically rather than theoretically.

> Traditionally parking is considered by the analyst as more in the realm of statistics than dynamics. (12)

But

> On no account must the parking problem be considered in isolation from traffic problems as a whole. (13)

As a basis for the work of improving the parking situation in the city, as much statistical data and direct observation as possible must be assembled. The more figures that are available, the more surely can future developments be gauged. Because of the break in the series of figures such as, for instance, the number of households and dwelling units, and car ownership level in every district, the author offers his own mathematical formulae (equations) for calculating (however approximately) present car parking needs, as well as likely future needs. This has been done by estimating ownership and population growth in relation to parking facilities. These equations are presented at appropriate places in this text. The calculation of the present need for parking space is extended to cover the entire city.

0.5 Structure of Thesis

This thesis is divided into eight chapters, excluding the Introduction and Conclusion. Chapter 1 discusses the physical and historical geography of Makkah and shows how the city grew and how the road system is largely unsuitable for the modern age, being the product of the era before motor vehicles. Chapter 2 continues this theme by showing how road improvements have been made in conjunction with the increase in the number of motor vehicles in Makkah. Chapter 3 then shows how different modern transportation methods play a significant role in population mobility for different purposes. The aim here was to establish whether private car ownership affects the role of public transport in the city. The rapid increase in the number of private cars has accelerated the decline in the level of public transport services. Specific transport problems, namely congestion, unpleasant environmental conditions (noise, air pollution) and road accidents which are the result of the rapid increase in the number of private motor vehicles, are discussed in Chapter 5. Chapter 6, 7 and 8 together show different aspects of the effects of the rapid increase in the number of private vehicles, such as access to different institutions and buildings, and the effect of land-use, topography and weather on the behaviour of people in using car parking facilities. These chapters also ask whether the available parking facilities cope with demand for parking space. Various key locations in the city are investigated around Al-Haram, at hospitals, shopping centres, residential areas, and educational institutions. The purpose of focussing on car parking is to discover whether car parking is the major transport problem in Makkah as it is in other cities in the Saudi Kingdom. For instance, in the city of Jeddah (the gate of Makkah) in 1977 most car parks in the city centre were filled beyond their practical capacity (over 7,000 vehicles were parked in 4,000 spaces). Underprovision in Jeddah was evident by car parking on the access and circulatory routes "jamming" the car parks. In spite of achieving some progress in expanding surface car parks and incorporating car parking decks within new developments at some commercial centres in Jeddah, there is still a large shortfall in the planned parking provision [14]. In addition to that in Al-Madina, the car parking problem, specifically around the first circular route, reaches saturation point because of the shortage of car parking spaces [15]. Comparing the problem of car parking in the city centre of Jeddah and the city centre of Makkah where Al-Haram and the commercial area adjacent to it with a multi-story car park with a capacity of 600 cars and the other car park far from the city centre (900 metres) with a capacity of 450 cars and considering the Al-Haram area when over 20,000 [16] motor vehicles were entering and terminating at Al-Haram area before Friday prayer on the 25th of Ramadan (23 May 1987), what would the traffic situation be in the absence of sufficient car parking facilities if streets were used entensively instead? So, car parking problems in the city require much attention from researchers. If this problem remains out of control it could paralyse the city and cause considerable damage to the city environment. This is because

> ... the most interactive physical element of the land-use and transport system is the parking facility.

and

> It is important to stress that parking facilities affect the dynamics of land-use and transport performance to a similar extent as a highway bottleneck. The feedback effects not only produce rapid re-adjustments in the total system, but parking represents an extremely powerful planning control. For example, a decision to restrict general parking in a (CBD) can change the model split substantially [17].

> Without control, parking on the street can lead to dangerous traffic conditions and to the loss of road space needed for moving traffic. Uncontrolled street parking impedes loading and unloading and encourages double parking, leading to serious traffic congestion. Cars are often parked too close together making it difficult for vehicles to enter or leave the parking spaces; not only difficult but also dangerous for moving traffic and pedestrians (18).

Thus, studying car parking problems in Makkah is of great importance, and urgent action from the city authorities will be seen to be vital. Indeed, parking is now, in many towns,

> the key to proper traffic control and transport policy implementation (19).

Chapters 6, 7 and 8 also discuss the suitability of the location of certain important centres in the city and whether their distribution affects the access of people. Thus:

> Many scholars have argued that the care with which people can reach employment locations, retail and services outlets, and recreational opportunities, should be considered in any assessment of the health of a city (20).

Through the eight chapters of this thesis, and its Conclusion, a number of specific recommendations are made. These are summarised in Section 9.4 of the Conclusion. If implemented, some of these ideas, it is hoped, would contribute to the solutions of the transport problems which currently prevail in Makkah at present and which seem likely to grow in future.

0.6 Problems Encountered

It has to be admitted that several problems were encountered which made this research difficult to complete. Not only is statistical data sparse, but sometimes it does not exist at all. The lack of access to studies and official reports about the city presumably because of their confidentiality was a major frustration. Moreover, the author's limited financial budget obviously affected the conduct of fieldwork, while his own efforts were inevitably limited by his personal energy budget, which no enthusiasm could extend. In addition, we faced some problems while conducting fieldwork interviews in 1985, 1986 and 1987. Those problems are:

1 The number of dwelling units is not known. That they are not numbered creates sampling difficulties.

2 In the socio-economic survey, because of the head of the household being at work in the morning we were forced to carry out the survey in the evening for just a few hours between 17.00 and 20.00 hours, which extended the time necessary to distribute 1200 survey samples and so put us behind schedule (see Chapter 3).

3 Detailed requests about journeys made by household members were difficult to obtain especially where asking about female journeys for socio-cultural reasons. This limited the analyses to male journeys, which clearly fails to illustrate population mobility as a whole.

4 There was little value in replies from people who did not take the questionnaires seriously or answer realistically.

5 Furthermore, the small size of the team of helpers made it difficult to speed distributing questionnaire samples.

6 Because the team which helped to distribute the

questionnaire samples were students from the Department of Geography, Umm Al-Quara University in Makka, who had lectures to attend, progress was very slow, which put us under pressure to extend the plan of work from three to six months.

7 Refusal of people interviewed in the socio-economic survey to give figures about their income level prevented further analyses in connection with car ownership.

8 It had been hoped to include an investigation about the journey to school: how it is made, the suitability of school distribution according to student hours, and locations. Such investigations were, however, impossible because, at the time when the socio-economic survey was conducted, apart from students at the University who had summer courses, students were on national summer holiday.

9 Several people spoke neither Arabic nor English, causing communication difficulties.

10 There were some complaints from interviewees about the length of the questionnaires and the type of questions asked, such as 'how many members are there in your family?', 'how many cars have you?' and 'why are you here and going there?'.

11 The hot weather conditions (see Chapter 1) discouraged people from co-operating with us especially in those questionnaires required to be conducted on city streets, in bus stations and in shopping areas. Moreover, the hot, sunny

weather also discouraged us from conducting any work in the open air between 11.00 and 16.00 hours, except in very limited situations such as counting vehicles parked at shopping areas continuously from 09.00 to 20.00 hours.

The general nature of statistical data concerning road traffic accidents in the city resulted in some rather general conclusions, whereas it had been hoped to make an in-depth analysis. This was to establish how far road accidents correlated with each hour of the day, weekdays and weekends, weather conditions (sunny, cloudy, hot, rainy, dusty), their spatial distribution, and the suitability of road layout, adequacy of road signs, etc (see Chapter 5).

Data about the number of people making Ummra (Little Pilgrimage) outside the period of Hajj, and how their number varies from season to season, weekdays and weekends, and their origin (inside or outside Saudi Arabia), does not exist. Such data would be very helpful in establishing their demand for transportation and parking facilities, their ease of access to the Al-Haram area, and the sort of transportation problems they face. This subject requires further research.

It had been hoped to measure levels of noise and air pollution in a range of areas covering the major roads of the city road network. Also, it had been hoped to extend this monitoring over a substantial period of time in order to establish a clear picture of seasonal variations in levels of noise and air pollution. However, a number of factors prevented the realisation of our hopes. The time limit for research was only four years, and measurements could be made only during the summer holidays. The limited range of instrumentation available prevented the simultaneous measurement of temperature, humidity and wind direction. (Such instrumentation would have been necessary to establish their relationship with levels of noise and air pollution, and their relationship with traffic volume on the city road network.) The limited function of the instrumentation available to us for measuring air pollution (only carbon monoxide) made establishing levels of other car exhaust pollutants difficult, and, therefore, comparison with research elesewhere. The instruments we had were not entirely automatic, and this created such difficulties as to leave little choice but to limit the time spent on measurements.

Given the time constraints, it was difficult to cover every transportation problem, and impossible to investigate some of them in any depth (e.g. parking demand at government offices, access to office locations by employees and the public, the demand for parking space at mosques).

The lack of detailed maps, such as geological maps, structural maps and climatological maps, also made it difficult to support some of the ideas discussed in this study.

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CHAPTER 1

ASPECTS OF THE PHYSICAL AND HISTORICAL GEOGRAPHY OF MAKKAH

1.1 Location

Along the western coast of Arabia, from the Gulf of Akaba in the north to the Strait of Bab el Mandeb in the south, lies a narrow, sandy plain, varying in width between 50 miles and less than two. This plain is known as Tihama. Bordering Tihama to the east is a range of rocky mountains.

Situated to the east side of the Red Sea, roughly half way between the Gulf of Akaba and the Strait of Bab el Mandeb, lies the port of Jeddah. Some 20 miles to the east of Jeddah, the lower spurs of the Al-Sarrat mountain range rise over the coastal plain. A further 20 miles inland, among winding chains of barren mountains, lies Makkah, its people cut off from free intercourse with the rest of the region by the sterile nature of its environment (1).

1.1.1 Site and Situation

Makkah is located in the western region of Saudi Arabia, often called Al-Hejaz region (2), $21^{o}25'$ north of the Equator and $39^{o}44'30''$ east of Greenwich. Its elevation above sea level is 280 metres (3). The city is situated in the heart of a valley, expanding naturally from the Al-Sarrat mountains which form a natural barrier, separating Najad (to the east) from Tihama (in the west) (4). Makkah is shaped like a crescent which lies in a deep, narrow valley. The valley runs from north to south with a slight easterly trend. The valley of Makkah has three outlets:

a To the north is the ravine, El Muabda, bearing to the east, leading to Arafat, Al-Taif and Najad.

b To the south is Al-Missfalah, leading to Wadi el Tarafyn and the Yemen road.

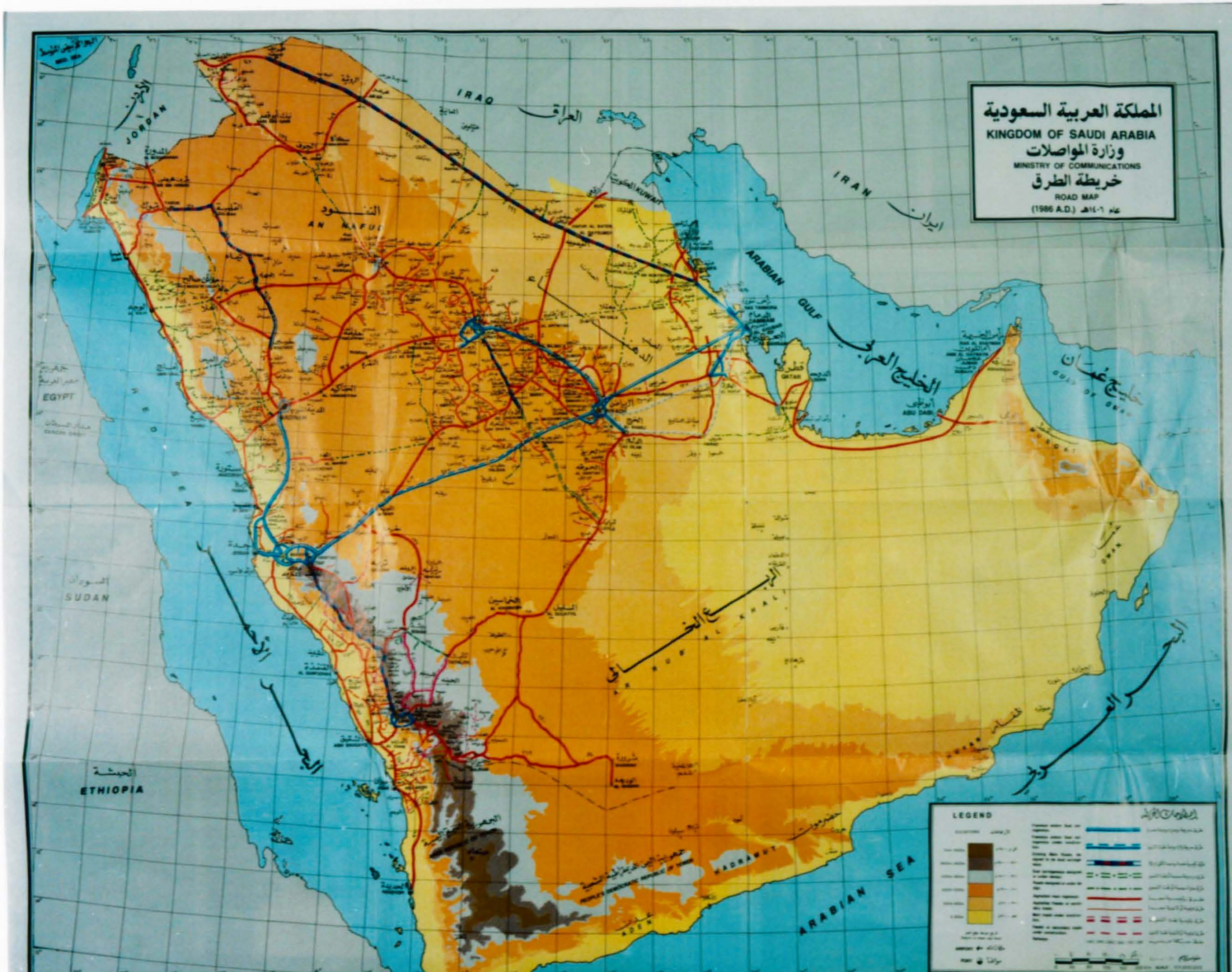
c To the south-west is Harat el Bab, leading to Jeddah and the Al-Madina road (5).

The city plays a significant role in connecting neighbouring cities. For example, Al-Taif, about 92 km to the east; Al-Madina, about 450 km to the north; and Jeddah, about 73 km to the west. This last city is the gateway between the city of Makkah and the rest of the world, since it has a sea port and airport, which Makkah lacks (see Figure 1).

1.2 The Origin of Makkah

According to Muslim historians, the existence of Makkah dates back to the year 1892BC, when the prophet Abraham discovered the site of Makkah, supposedly after being ordered by Allah (God) to migrate there from Syria. Abraham brought Hagar, his wife, and their child, Ismail to this gorge, between rocky hills, parched and barren under the Arabian sun, where it is impossible to live without water.

In accordance with Muslim belief, when Abraham left his wife and son in Makkah to return to Syria, a miracle happened in the appearance of Zam-Zam, a well of water. This incident is considered the prime factor initiating the city.


المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA
وزارة المواصلات
MINISTRY OF COMMUNICATIONS
خريطة الطرق
ROAD MAP
(1986 A.D.) عام ١٤٠٦هـ
IRAQ
العراق
IRAN
ايران
JORDAN
KUWAIT
EGYPT
SUDAN
السودان
ETHIOPIA
الحبشة
AN NAFUD
النفود
ARABIAN GULF
الخليج العربي
QATAR
قطر
ABU DABI
ARABIAN SEA
البحر العربي
البحر الأحمر
الربع الخالي
LEGEND

After a short period of time the prophet Abraham returned to Makkah to visit his wife and son, and was ordered by Allah to build the Kaaba. This was the first place to be built and the main origin of the city. After Abraham had completed the Kaaba, he was told to encourage people to perform Hajj. This was considered another contributory factor leading towards the city's birth. People were encouraged to stay in Makkah, at least for a short while, in order to complete the Hajj ceremony. Some decided to live there permanently.

1.3 The Growth of Makkah

According to Muslim belief, Allah selected this isolated and lonely place in the midst of the barren foothills of the Arabian Peninsula to be a new residence for Abraham and his family.

After the well of Zam-Zam miraculously appeared, and before Abraham began to build the Kaaba, the Arab tribe of Beni Jorham came to settle in Makkah, with the permission of Ismail and his mother. Ismail then married into the Jorham tribe. He considered the well of Zam-Zam to be his property. After his death, the Jorham tribe inherited the well of Zam-Zam and Kaaba (6). Afterwards, the tribe of Kuza'a kept possession of the Kaaba for about three centuries. Qusay Ibn Kilab was one of their successors (7).

In the time of Qusay Ibn Kilab (fifth to sixth century AD), permanent dwelling houses were first built in the valley of Makkah, although the majority of dwellings were houses or tents of hair cloth. After the death of Qusay, the Quraysh improved and enlarged the town (8).

The Quraysh tribe used natural materials for building their houses and confined themselves to the valley, because Qusay Ibn Kilab did not allow people to build their houses on mountains surrounding the site of Kaaba. He did not wish any building to be sited higher than it for reasons of respect (9). It can be deduced that most houses were one storey.

1.3.1 Makkah During the Caliphate Period

At this time, there was a high density of houses around the holy mosque, because most of the migrants from the Islamic world preferred to be near it. The tribes formed suburbs on the outskirts of Makkah (10).

During this period, the site of the city was expanded by the second Caliph 'Omar Ibn Al-Khtab, who first built a mosque around the Kaaba in the year 17AH, about 638AD. This Caliph discovered that the mosque was too small to cater for the number of people performing daily prayer, so he bought the small houses around it and demolished them, the space created thereby becoming part of the mosque. This Caliph was also the first to build a wall round the holy mosque (11). Houses demolished at the time of the Caliph Omar to expand the area of Al-Haram were rebuilt elsewhere, thereby adding to the expansion of the city, but no data has been found concerning the built up area of that time.

In 27AH (about 648AD), 'Uthman Ibn Afan, the third Caliph, enlarged the square of the mosque. By the end of 40AH (661AD) the size of the built-up area in Makkah was 165,000 square metres, about 16 hectares.

1.3.2 Makkah During the 'Ummayad (662-750AD), 'Abbasid (750-1258AD), Fatimid (1258-1500AD) and Ottoman (1699-1924AD) Periods

During the Ummayad Caliphate, Makkah experienced little growth. Any real growth occurred in the reign of Caliph Ibn Al-Zubayr. He enlarged the enclosure of the wall by purchasing properties from Makkah's residents and after levelling them, included the area within the mosque. By the end of the Ummayad Caliphate in 132AH (about 752AD), the area of Makkah was 346,000 square metres. At that time, the boundaries of Makkah extended from Al-Raia Mosque to the east, and to Shubikah Square in the south-west [12].

Throughout the Abbasid Caliphate, Makkah did not undergo as much growth as happened during the Ummayad Caliphate, because the development of Al-Hejaz region was neglected, causing many of Makkah's residents to emigrate to Syria. Iraq, Egypt and Morocco. The only growth that the city witnessed at this time and during the Abu Ja'afar al-Mansoor Caliphate in 139AH (about 759AD) was the expansion of the north and south sides of the mosque which was enlarged to twice its previous size [13].

In 163AH (780AD), the Caliph Al-Mahdy added to the size of the mosque by buying land from Makkah's residents [14].

During the Fatimid Caliphate, Makkah experienced little settlement growth, although many castles were built by the Caliphs themselves. The size of Makkah by 923AH (1512AD) was 588,000 square metres. Up until 1100AH (1689AD), Makkah was a good example of an Arabian Muslim town, where the mosque and squares represent the basic centre of the city. The reason for this is that Islamic instruction, guidance and social affairs were directed by rulers of cities from such centres. Afterwards, mosques and squares which surrounded the rulers' houses functioned as basic centres for these cities' activities. By this time, Makkah had developed its important core (the Holy Mosque) and an open square round it which was bounded by a residential area. Small shops filled in where possible and smaller mosques were built, scattered throughout the city [(15)].

In the Ottoman period (between 1000AH and 1343AH: 1699-1924AD), Makkah came under Turkish rule. During this time, the built-up area enlarged considerably to meet the ever-incerasing number of pilgrims. Most of the streets which were constructed at this time were unpaved and were expanded to meet heavy traffic movement during and outside the period of Hajj [(16)]. In this period the city area grew up to 1,400,000 square metres [(17)].

One of the visitors to Makkah in the 18th century was Burckhardt. He described the city thus:

> Makkah may be styled a handsome town, its streets are in general broader than those of eastern cities, the houses lofty and built of stone; and the numerous windows that face the streets give them a more lively and European aspect than those of Egypt or Syria, where the houses present but few

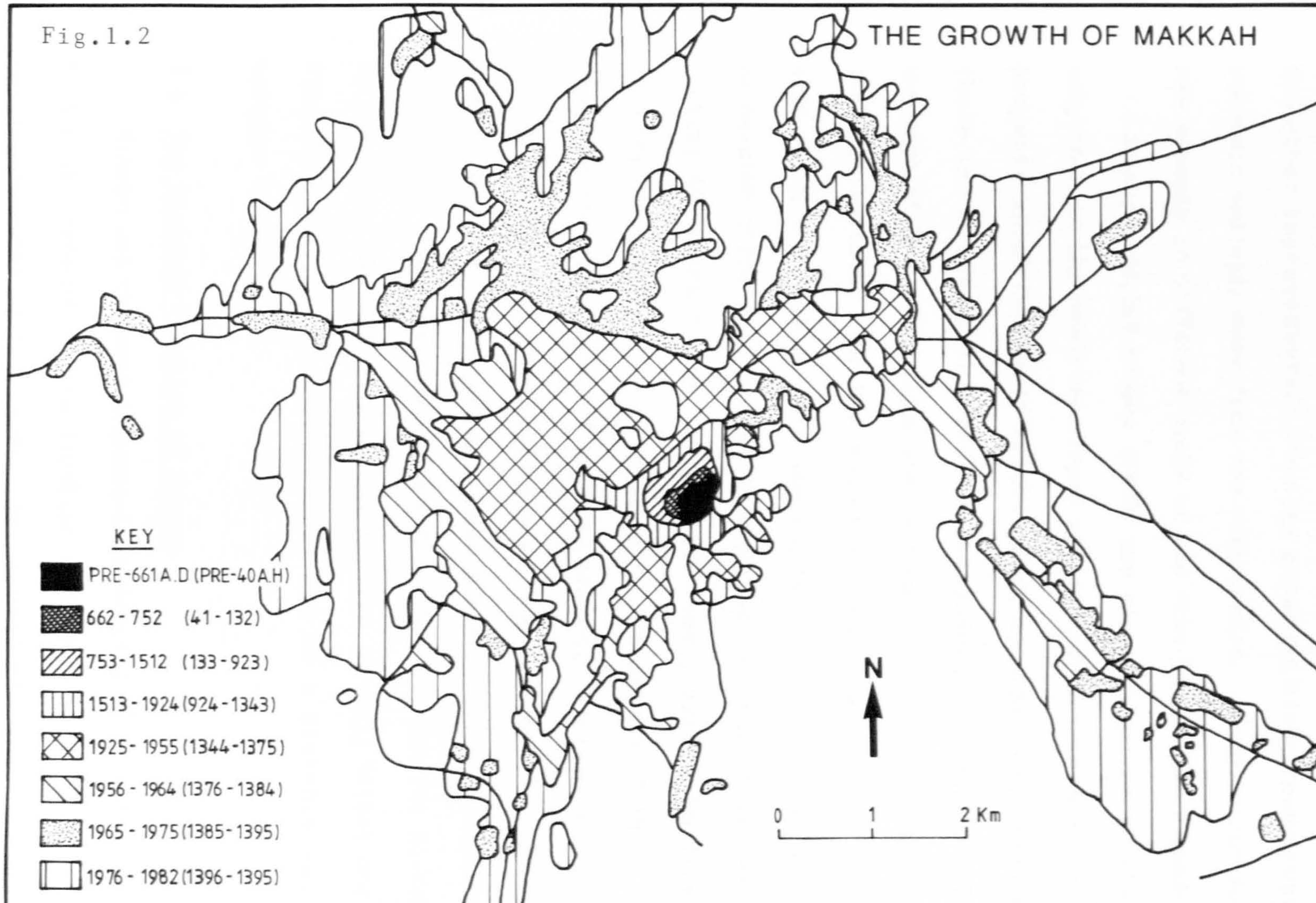
windows towards the exterior. In most towns of the Levant, the narrowness of the streets contributes to its coolness; and in countries where wheel-carriages are not used, a space that allows two loaded camels to pass each other is deemed sufficient. At Makkah, it was necessary to leave the passage wide for the innumerable visitors who here crowded together and it is in the houses adapted for the reception of pilgrims and other sojourners, that windows are so contrived as to command a view of the streets.

The streets are all unpaved; and in summertime the sand and dust in them are as great a nuisance as the mud is in the rainy season, during which they are scarcely passable after a shower; for in the interior of the town the water does not run off, but remains till it is dried up. (18)

1.3.3 Modern Makkah

The city of Makkah is ancient, but is regarded as eternal, as symbolised by the Kaaba and the Holy Mosque. This has resulted in continued expansion. During the period of the Saudi government between 1343AH and 1375AH (1924AD to 1955AD) when petroleum was discovered in the Kingdom, and from then to date, with the establishment of a stable nation-state, Makkah has undergone rapid growth. The city expanded in all directions. By 1968, it had grown to cover an area of 19,73,000 square metres (1112 hectares) (19). In 1982, the total area of Makkah city was about 150,000 hectares, while the built-up areas were around 4800 hectares (20). Fast and convenient methods of transportation also helped the city towards this rapid expansion and growth (see Figure 2).

Through its long history, the change in the city has been great. During the past two decades there has been a new era of development and expansion. Modern planning has been applied in



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recent years, focusing on modern communication, public services and other improvements. The city expanded along roads through mountain valleys, away from the city centre. The construction of new streets in different parts of the city helped its expansion.

Makkah's 35,269 houses (1970) are closer together in the old city than in the newly developed residential areas. With the new projects which have been established, many houses, especially those in the old city, have been demolished in order to enlarge the area of the holy mosque and to construct new and wider roads. The city extended over the mountains located within the city and also along the main streets leading out of it. Such streets are Al-Aziziah Street, to the north-east, about 11 km from the city centre; Al-Taneem Street, to the north-west, about 8 km from the centre; Al-Missfalah, to the south at a distance of about 4 km; Jiyad to the east, about 2 km from the city centre; and Umm al Daraj, to the west, about 8 km from the centre (21). In 1984, new streets were constructed. These streets are: Al-Rassifah, to the west of Al-Haram, about 7 km from the city centre; Al-Kakia, to the south, about 8 km from the centre. Al-Hajj Street and Al-Taneem Street, north of Al-Haram, are at a distance varying between 7 and 9 km.

1.4 The Historic Function of Makkah

Makkah was the most important commercial city in the Arabian Peninsula, because of its location mid-way between Syria in the north and Yemen in the South. The market of the city was much visited by traders from abroad. Traders brought products such as glue and wood from Africa, leather goods and clothes from Yemen. Indian spices from Iraq and oil, cereals, silk and weapons from Egypt and Syria. Most of these products were sold in Makkah to local inhabitants and to people from abroad. Additionally, in the Quryash Period, Makkah gained the importance of being the centre of money exchange, equivalent to the banking system today. Above all, the status which the city acquired after the prophet Abraham came to it was the religious one (22).

1.4.1 The City Function in the Islamic Period

Since the beginning of the Islamic Period, Makkah has continued to grow, and gained additional spiritual importance following the Prophet Mohammed and the birth of Islam. From this time, Makkah was not founded so much on trade and a source of material gain, but flourished as a religious and spiritual centre for the Muslim world. Finally, the city gained additional importance when it became the capital of the Al-Hejaz region in 1911 (23).

1.5 The Structure of the City

The old city and the area immediately around it form the historic core of the holy city which clusters around the Haram, the focal point. This area has developed over the past centuries to serve the specific purpose of providing both residential and allied service areas for people wanting to live near the Haram. This natural desire to live near Al-Haram has led to the use of all available space to provide living and shopping facilities. Roads, squares and other open spaces have suffered in the search for building sites.

In addition to the shopping areas adjoining the residential areas around the Haram, some banking facilities were also incorporated to provide for the financial transactions of the Hadjis (pilgrims). The characteristics of this area are:

a dense residential housing;

b seasonal housing units;

c commercial areas.

As the city grew, development of the areas around the Haram formed the same pattern in so far as the topography would permit. Shopping and commercial activities followed the main road to and from the centre, diminishing in size and importance according to their accessibility and proximity to the Haram.

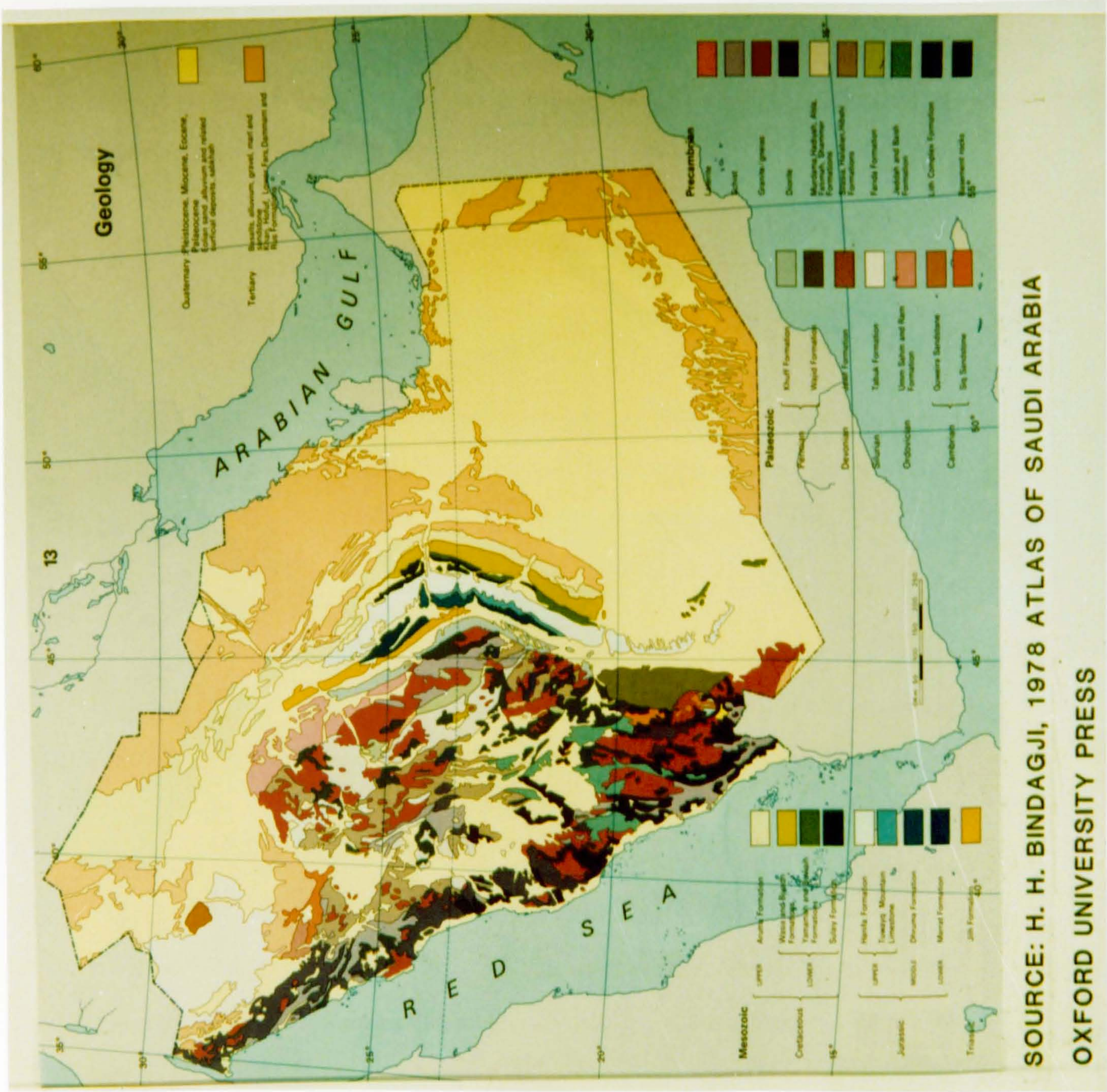
A major feature of the city structure is the grouping of communities by country of origin of the Hadjis who, in the past, preferred to stay on and settle in the holy city. Many African people, for example, have gathered in an area to the west of Makkah. However, due to low incomes, this trend has led to the growth of sub-standard housing in many of the out-lying areas,

With the need for additional residential areas, due to the continuous increase in population and with the presence of modern transportation facilities, it became possible to break the established pattern of development. New residential areas, containing the necessary supporting services, have now sprung up away from the Haram. At Al-Zahar, for example, an area fairly distant from the city centre, a modern development of houses and villas is taking place. The need to create new city streets has resulted from traffic demand.

The mountainous terrain prevents the development of an airport in the vicinity of Makkah. Jeddah airport thus serves both Jeddah and Makkah. The structure of the city and the nature and distribution of the major land uses historically have grown and developed to serve the holy city's dominant function as the spiritual centre of the Muslim world and, as part of this, to welcome many hundreds of thousands of pilgrims each year [24], as well as those who come regularly during the year to perform Ummrah (little Hajj) and to visit the holy Kaaba and Mosque.

1.6 The Geological Structure

The geological structure of Saudi Arabia was set in the Pre-Cambrian era and results from two major geological divisions: the Arabian Shelf and the Arabian Shield, in the east and in the west respectively [25]. The Arabian Shield forms the almost straight 2,000 km long eastern shore of the Red sea and it extends inland for as much as 800 km to form the Plateau of Najad, near Riyadh [26]. This vast Precambrian complex, comprising schists, gneiss and granite rocks, occupies roughly one third of the western Arabian Peninsula (Figure 3). The Arabian Shield is a massive formation of ancient igneous and metamorphic rocks which has



Geology
13
ARABIAN GULF
RED SEA
Mesozoic
Palaeozoic
Precambrian
Quaternary
Tertiary
Cretaceous
Jurassic
Triassic
Permian
Devonian
Silurian
Ordovician
Cambrian
SOURCE: H. H. BINDAGJI, 1978 ATLAS OF SAUDI ARABIA
OXFORD UNIVERSITY PRESS

Fig.1.3

undergone little folding since the Cambrian period. The later stages of the Eocene, Miocene and Pliocene periods were accompanied by deep-seated faulting which brought lava to the surface and, as a result of geological evolution, extensive lava flows of Tertiary and Quaternary origin developed in north and south Arabia [27].

The city of Makkah is situated in an area of crystalline rocks which include igneous and metamorphic rocks such as schists and gneiss. The area also contains granitic rocks of Pre-Cambrian age [28].

The exposed bedrock in Makkah is composed predominantly of granites, granodiorites, diorites and dyke intrusions. This group of rocks is part of the Nubo-Arabian Shield [29].

1.7 The Physical Geography of Makkah

Makkah is shaped like a crescent which lies in a deep, narrow valley. The valley runs northwards with a slight easterly trend. The city lies amid a complex of rugged mountains and alluvial valleys. The hills rise adjacent to the valley, to between 200 and 400 metres above its floor. The city's relief is called Al-Bitah. The famous Zam-Zam well is located in the valley, together with the holy Kaaba, at an elevation of 277 metres above sea level. These topographic conditions cause the Al-Haram area and other areas along the valley water course to be exposed to flood action [30].

1.7.1 Relief

The topography of Makkah is complex with numerous mountains with unique physical characteristics and historical associations. These mountains are:

Thawur Mountain

Located to the south of Makkah, Thawur Mountain rises to 759 metres. The route to it from Al-Haram passes through mountains on both sides over a distance of 8 km. From the summit of Thawur Mountain, Makkah and the surrounding mountains may be seen clearly. On this mountain is the cave in which the Prophet Mohammed and his friend, Abu Baker, hid from the Quraysh tribe after they had rejected his message. From here, they left secretly for Madina, an event known as the "Hijra", which indicates the beginning of the Islamic calendar.

Hira Mountain

Hira Mountain lies to the north of Makkah and to the west of the route to Arafat Plain. It rises to a height of 634 metres above sea level, and has rough slopes on all sides. From Hira to Al-Haram is 13 km. Hira mountain also has a cave, facing the holy Ka'aba in which the Prophet Mohammed used to meditate before he became the messenger of Allah. In this cave, Mohammed received the first message of the revelations which were to become the Qur'an (31).

Abu Qubays Mountain

Abu Qubays Mountain lies to the east of the Holy Mosque. Its height is 372 metres and its slopes trend roughly toward the east and north-east, where it extends and takes the name of Khandama Mountain, the summit of which rises to 420 metres. At the peak of Abu Qubays Mountain is the Bilal Mosque. Since the mountain is located just a few metres from the eastern wall of the holy mosque, many people have built their houses on its slopes so as to be close to Al-Haram. These houses are clustered so compactly that it was necessary to build flights of steps instead of streets, to reach them. The street which is situated between the holy mosque and Abu Qubays Mountain is very narrow (about eight metres) and creates congestion for vehicle movement.

Qaiquan Mountain

To the west of Al-Haram, Qaiquan Mountain faces Abu Qubays Mountain. It rises to 430 metres and slopes steeply towards the east, south-east and west. Qaiquan Mountain is part of a complex mountain chain which extends in a northerly direction. It has several names, depending on location, and in recent times, has become known as Hindi Mountain. Since this mountain also lies close to the Holy Mosque, many people have built their houses on its slopes. Streets were built on this mountain, the slopes of which allow road construction, unlike on Abu Qubays Mountain. However, flights of steps are sometimes built where streets cannot be constructed to reach the houses. The gap between this mountain and the Holy Mosque permits the building of a street, the width of which is rather more than 12 metres.

Ummar Mountain

Ummar mountain extends from Ash-Shabikah districts to the Al-Missfalah district, from north to south. It lies to the west of the Holy Mosque. It is the northern part of the mountain chain, parallel to the Qal'at Jiyad mountain chain.

Qal'at Jiyad Mountain

Located to the south-east of the holy mosque, between Jiyad and Missfalah streets (known as Al-Misial Street and Misial Al-Harasani Street) and rising to 406 metres, sloping gently towards the north, this mountain is named 'Qal'at Jiyad' because of the castle which is located on its summit. This castle also faces north towards the Holy Mosque.

Adhakir Mountain Chain

The Adhakir mountain chain lies to the north of the Holy Mosque and rises to about 426 metres. The peak of this mountain chain is located in the northern part at 442 metres and slopes abruptly eastwards.

Kaaba Mountain

Kaaba mountain lies to the north-west of the Holy Mosque and rises to an elevation of 340 metres, sloping gently in all directions. This mountain is named after the rocky stones which were taken to build the Kaaba.

Al-Rkham Mountain

Al-Rkham mountain lies at the upper part of Makkah, to the north of the holy mosque. It rises to 883 metres and has rough slopes in all directions.

Bani Amir Path

Bani Amir Path is located to the north of Al-Gaza Street. This path is famous as the birth place of the Prophet Mohammed. It is very densely settled and lies just 300 metres from the Holy Mosque [32].

Al-Hajoon Path

Al-Hajoon Path lies to the north of the Holy Mosque, about a kilometre from Al-Haram. Its fame is due to the Prophet Mohammed's entry into Makkah this way [33].

It can be concluded that the city network is affected by the complex of mountains and the valley water course. The city's primary and secondary streets follow the natural water course of the Makkah valley, since the mountains limit their development. As the built-up area extended over the mountains, other types of roads were constructed, unlike the city streets. These roads are very narrow, often stepped, and are unsuitable for vehicles.

1.8 Climate

Makkah is very hot in summer, warm in winter, and dry for most of the time. Breezes seldom reach the city because of the surrounding hills and its distance from the Red Sea (the shore of which is about 75 km from the city). Wind conditions in the city are variable. For about 50 percent of the time winds are south-westerly; the remainder are predominantly north-westerly and north-easterly. Winds are relatively cool, except in the summer when they are hot and carry dust and sand from the south [34]. The south-westerly wind is usually very dry when it reaches Makkah, because it has been passing over land surfaces for a great distance [35].

1.8.1 Temperature

Climatic data are available for a only short span. The annual average temperature is 31.0°C. Such a high temperature occurs because:

1 Makkah is far from the effects of the sea;

2 High mountains surround the city; and

3 Makkah is within the tropical limits, which means that the sun is almost directly overhead.

1.8.1.1 Summer Temperature

In August, the maximum temperature is 42,0°C and the minimum 39.8°C. In June, the maximum is 45.8°C and the minimum 35.6°C, while in July it is 42.6°C maximum and 36.7°C minimum. In September, the maximum is 41.4°C and the minimum 35.2°C. From the average of these temperatures it can be seen that June is the hottest month.

1.8.1.2 Winter Temperature

The maximum is 29.0°C in December and 29.5°C in January, while the minimum in both months is 24.5°C. The weather in this season tends to be warm.

1.8.1.3 Spring and Autumn Temperature

The maximum temperature in April is 35.9°C and the minimum 30.4°C. These figures increase by October to a maximum 38.6°C and a minimum 32.6°C.

1.8.2 Wind Direction and Pressure

In summer, the sun is directly overhead at the Tropic of Cancer. Consequently, Central Asia has a low pressure belt which influences the Arabian Peninsula, where there is also a low pressure belt, due to the percentage of land being greater than the percentage of water bodies. In contrast, the Indian Ocean and the Mediterranean Sea both have high pressure zones. Consequently, Makkah is influenced by the following winds:

a the north-western winds, which are mostly dry because of subsidence and the absence of large water bodies to produce water vapour;

b the north-east trade winds, which are also dry because they pass over the desert region of the Arabian Peninsula;

c the monsoon winds from the south-west which cause occasional summer rainfall.

In winter, a high pressure belt lies over the Arabian Peninsula. Two other high pressure belts affect the area: those of the Azores (in the Atlantic Ocean and northern Sahara) and Siberia. Low pressure belts are located in the Mediterranean Sea and the Indian Ocean. Consequently, Makkah is affected by the following winds:

a north-eastern trade winds, which are cool, but do not have much influence on the city, due to the mountains;

b north-western winds, which bring occasional wet storms from the Mediterranean (36).

1.8.3 <u>Rainfall</u>

Rainfall rarely occurs in Makkah, but when it comes it may be sudden and heavy. The entire rainfall for a month or a year may occur within one or two days, causing water to flow very fast along the valleys towards Makkah, causing flash floods which ruin houses and destroy roads. Travel is limited until roads are reconstructed, after evaporation of the rain water (37).

Total average rainfall for Makkah is 163.5mm (Table 1). Nearly 91 percent of annual precipitation falls in November, December, January and March, and is attributable to Mediterranean cyclones. The average rainfall in January is 6.34mm; December, 111.5mm; November, 21.2mm; October, 2.6mm; and September, 2.1mm (Table 1). However, when south-west winds (monsoon) reach Makkah during the summer, they cause occasional rainfall from April to June. Average rainfall in April is 7.2mm, while in June it is 1.2mm.

Table 1.1 <u>Monthly Distribution of Precipitation for Makkah (in millimetres)</u>

Month / Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1983	21.6	-	7.9	-	-	5.6	-	-	-	-	-	476	511.1
1984	7.1	-	-	0.6	-	-	-	-	0.4	-	18.1	12.1	38.3
1985	3.0	-	-	20.0	-	-	-	-	8.0	-	23.5	69.0	123.5
1986	-	2.9	24.0	15.2	-	-	-	3.0	2.0	13.0	64.0	-	124.1
1987	-	0.5	19.2	-	0.4	-	-	*	*	*	*	*	20.1
Average	6.34	0.7	10.3	7.2	0.08	1.2	-	0.8	2.1	2.6	21.2	111.5	163.5

Source: Kingdom of Saudi Arabia, Ministry of Defence and Aviation, General Directorate of Meteorology, Station Makkah, Umm Al-Juod.

* No data available, but average represents months calculated with the total average.

1.9 The Topography of Makkah

Topographically, Makkah is closely confined by steep-sided, barren hills which channel development along a series of valleys (wadis) - Abraham and Tundebawy valleys - and their interjacent valleys (rawafid). This topographical situation has been one of the major factors influencing the urban pattern and expansion of Makkah. It has restricted urban expansion to a limited number of horizontal directions, and up the lower slopes of the mountains. The street pattern has also been influenced by topography. The network of main roads radiates from the central area around the holy Haram, the centre of activity, and follows the meanderings of the valley. Secondary streets follow no particular pattern. Fortunately, however, the city has easy access, through a natural gap, to its Red Sea port of Jeddah.

In the 19th century, one of the travellers, Eldon Rutter, wrote about the topography of Makkah:

> Makkah is the largest town in the Peninsula of Arabia. The main street of Makkah may be said to commence at a place called Shaykh Mahmood, which is situated in that narrow branch of the Makkah valley - which turns out of the main wadi at an acute angle round the base of Jebel Quyqan. At this point the Jeddah road branches westward, from the main road which leads on to the wadis Fatima and El Medina. From this point the road, which averages twenty yards in width, proceeds south-eastwards and for more than half a mile is known as Jarwal. Like all the streets of Makkah, those in this quarter are quite unpaved, Jarwal itself is ankle-deep with loose grey sand.
>
> Beyond Jarwal, the road proceeds round the base of Quyqan Mountain, in a gradual curve, until it points eastwards. This part of the road is known as Harat el Bab. Beyond Harat el Bab, the street takes the name of Esh-Shubaykah. Sending out a narrow side-street, which passes beside the Haram in a north-easterly direction and joins abruptly to

the right in a south-easterly direction and leaving on its left the quarter called Harat el 'Omra, passes down a steady incline through the narrow jewellers' street called Zugages Suaq, into a wide market street known as Suk es-Saghir (Holy Mosque). Suk es-Saghir is in the main valley of Makkah and forms part of the wadi or watercourse which runs through it. The street narrows sharply as it approaches the southern corner of the Haram. Still in an easterly direction, the street bears to the right a little, in order to clear the southern corner of el-Haram. It then becomes broader again and skirts the south-eastern wall of the Mosque. This part of the main road is unnamed, but the first part of it is counted as part of Harat Jiyad, while the further end belongs to Harat es-Safa. From this point, the road crosses the Masa, and then bears to the left until its direction is due north. It is here called El Gashashiya, the principal boys' school of Makkah, it is situated at the point where it joins El-Masa. At a distance of five hundred yards or so beyond this school, the name of the street changes to Suk-el-Layl. To the right of this district lies the district known as Shiab Ali (Ali's Ravine). Further, the street takes the name El Ghazza. On the opposite side of the way, but further along, a narrow lane leads into the quarter known as Shiab Armir.

A few paces further on, the road converges upon and joins the market street known as El Jowdaniya, which under the name of El-Muddaa for the greater part of its length, extends from the Masa near El Marwa to this point.

The single street formed by the merging of El Jowdariya into El Ghazza is called El Maala. At the junction are situated the shops of the principal grain sellers. There is an open space whence the three roads meet, and here the way is bordered by a continuous double line of small shops, stocked with all sorts of food stuffs and household requisites. On the left-hand side of the way, immediately before reaching the graveyard of El Maala, is a large open space, about a hundred yards square. This is called El Halaga. At the northern end of this market place, which is surrounded by houses, the city may be said to terminate. Beyond this point of the market place, the road widens out to a breadth of thirty yards. After passing the cemetery called Jannat el Maala, the road becomes forty yards wide and is covered with deep coarse sand. This part is called El Muabda. Bearing at first to the north-east and then eastward, the road now passes on through the valley El Abtah, to a point some three miles further, where it bifurcates - the right-hand branch leads to Arafa and El-Taif, while the left-hand branch leads to El-Taif by the route of the Wadi El Yemaniya. At the bottom of El-Muddaa, one crosses El Masa

> and enters a dark narrow alley which is called Es-Suwayga. It runs parallel to the north-west wall of the Haram and is separated from it by a closely-built mass of houses divided by several narrow crooked lanes which lead to the several gates of the Mosque. That narrow street continues westward, until it joins the main street of the city. The quarter lying adjacent to Es-Suwayga on its north-western side is known as Esh-Shamiya. An important street runs north and south from El Halagga, to the high ground called Es-Sulaymania. This street is known to the south as En-Naga. Further south it assumes the name of El Falg. Between El Falg and the Suwayga market lies the quarter called El Garara. East of this is the quarter called Er-Rakuba, which extends as far as El Muddaa.
>
> Proceeding in a south-easterly direction, down Suk es-Saghir street, one finds that it bears sharply to the left at about 300 paces from the Haram gate called Bab Ibrahim. Situated at this bend, lies the quarter El Hajla. The road, after passing El Hajla, proceeds due south and is known as El Misfala. At its lower end where it enters the Wadi Et-Tarafayn, it converges with and ultimately joins two other roads: one coming from Jiyad and known as El Misyal (this is also a watercourse); the other coming from Suk es-Saghir, at a point nearly opposite the Zugag es-Suwag, and called Harat Abi Baker es-Sidig. (38)

The topographical aspects have changed markedly since the time of Eldon Rutter. Many roads and streets of the city are now wide and paved to deal with the introduction of motor vehicles. Some of the suqs mentioned by Eldon Rutter were removed to enlarge the area of Al-Haram, such as Suq es Saghir. Eldon Rutter mentioned that the city ended at the place called Al-Halqa (wholesale vegetable market), but the city now extends to north and north-east, reaching the border of Mina. Es Suwayga has been demolished to enlarge the Holy Mosque.

1.10 Administrative Districts of Makkah

In 1898 there were nine districts in Makkah. Those districts have certain amenities which people need during and outside the period of Hajj. One reason for the growth of the districts (Harah) is the need of space for people who migrated from the Islamic world to settle in Makkah for the rest of their lives. The nine districts are:

Jarwal, which lies to the west of Al-Haram. The most famous features in this quarter are the well of Dee Tuaa, the wide square where the Egyptian caravan used to stop and the Massafer Khanah. The streets in this district were wide and unpaved until the advent of the Kingdom's central government.

Al-Missfalah is situated to the south of Al-Haram.

Jyad Path is located to the east of Al-Haram. Path, in Arabic, denotes a narrow defile between hills, from which this district takes its name. It has many houses and the streets are wide and well organised.

Al-Qashashia is positioned between Abo Qubess mount and Al-Haram (its eastern side). To the east of this district there is Ali Path, where the Prophet Mohammed was born.

Al-Gazah is sited to the north-east of Al-Haram. This district is full of shops which are on both sides of the road leading to the upper part of Makkah.

Bani Aamir Path is to the north of Al-Gazah district.

Al-Shamiah encircles the Haram from the north and west. This district was very famous because of its important market, which disappeared due to the enlargement of Al-Haram in 1955.

Al-Gararah is to the north of Al-Shamiah. The houses in this district were built on the foothills and over the hills, so most of the streets are narrow, many of which have been created as stairs. People have difficulty in transporting water and building materials over the hills, and donkeys have to be used to carry whatever is needed.

Al-Sullimaniah is located to the north of Al-Haram, next to Al-Gararah and Al-Gazah. Near these districts are the smaller regions of Al-Naqah, Al-Manhanah, Al-Maabidah, Al-Bayadyah and Al-Maalah.

Most of the streets in these districts were very narrow and badly organised, because of the topographic effect. Jarwal is the exception (39).

From 1924 until the present, Makkah has expanded faster than ever before, due to the discovery of oil in Saudi Arabia. The Al-Haram has been greatly enlarged, leading to the demolition of houses in that area. This, in turn, led to the creation of new districts in Makkah and the building of modern roads in keeping with the city's development (40). Such districts are Al-Awali, Al-Sharaii, and Al-Kakiah.

1.11 The Main Function of the City Today

The main function of Makkah is its role as the most holy city of the Islamic world. Besides the deep religious significance of the Hajj, it is the city's main economic activity. The physical form of the holy city derives from the topography of the area and the dominant influence of Islam. The holy Haram, at the centre of Makkah, is the focus of urban life and grouped around it are the main religious, civic, social, cultural and commercial activities of the city.

Employment in the fields of construction, distribution, education, government service and professional services is slightly higher than in equivalent western urban areas. Evidently, the role of the city as a religious capital and as a place of pilgrimage, together with the associated education and distribution of educational services, is of primary importance. (Perhaps partly as a result of the importance of the distribution sector, a remarkably high proportion - 48.5 percent - of the work force is self-employed.) This impetus would seem to be complemented by substantial employment in government service and by sufficient demand from both public and private sources to support a considerable construction sector (41).

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CHAPTER 2

DEVELOPMENT OF MAKKAH'S ROADS

2.1 Introduction

Following the initial growth of Makkah in the centuries when the land use pattern followed the city's topographical features, more intensive land use around Al-Haram and its immediate area began. A kind of Central Business District (C.B.D.) combined with narrow streets and a shortage of open space were emergent characteristics. This Chapter is devoted to the study of the city road network from earliest times. The aim is to establish whether the city network has experienced problems related to the tendency towards intensive land use within the city in the past. Thus, the condition of roads in the city will be discussed at different stages of growth. The Chapter also tries to establish the effect of these problems on methods of transportation and on traffic flows and what kind of strategies have been followed to improve the city network, in order to deal with the demand for movement within the city.

2.2 Makkah Street Patterns

Makkah's streets four thousand years ago were full of rocks, stones, sand, gravel and thorn trees which sprang up here and there over the open land of the city. In addition, the land surface of the city was characterised by many steep slopes, which prevented pedestrians from walking without much effort (1).

It is obvious from the foregoing that ancient Makkah had no wide or purpose-built streets, but when the Prophet Abraham migrated with his family to Makkah and settled down, this was a turning point for the city. The migration of the Prophet Abraham and his family produced early attempts at the formation of passable streets around the Kaabah (House of Allah) which was and still is the core of the city.

Road building in Makkah can be divided into three periods: the pre-Islamic period; the Islamic period; and the present period, dating from the founding of the Kingdom of Saudi Arabia. The purpose of the following sections is to study the development of needs for streets, and the associated problems, from the time of the migration of the Prophet Abraham. The nature of the topography and motives for movement within the city created pressure for streets to cope with traffic leading to and from the city.

2.2.1 The Pre-Islamic Period Street Pattern

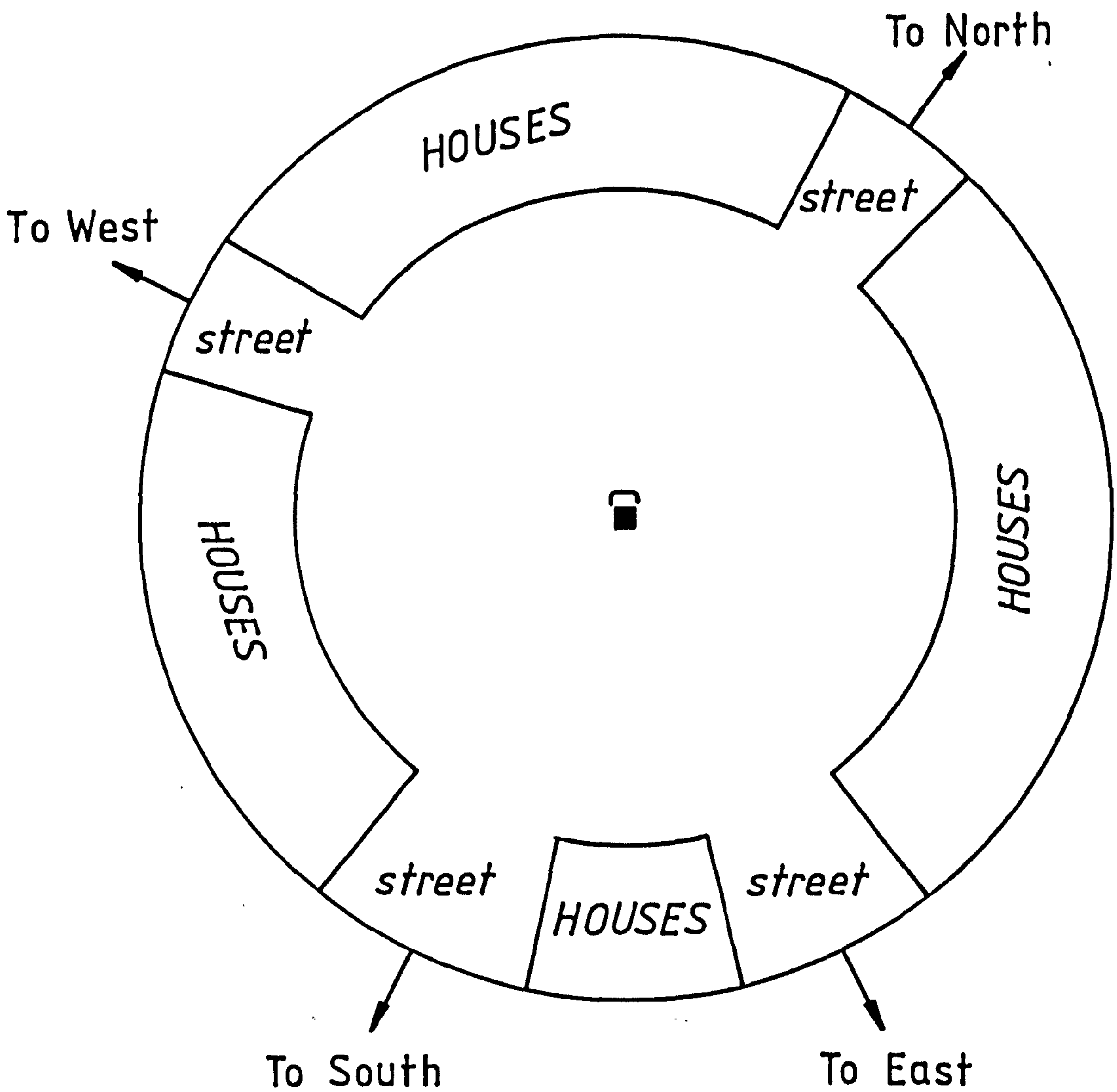
After the Prophet Abraham had left his wife and son Ismail in Makkah, the Jurham tribe came to settle in the city and the number of people gradually increased, along with the number of houses. Movement within the city was achieved with great difficulty because of the natural barriers, such as rocks, gravel and thorn trees. These obstacles were removed to allow the movement of traffic. At this stage, the streets were characterised as being short and narrow, sufficient for the demand of movement required by the inhabitants of only a few houses and allowing them to move freely in different directions. Most of the houses stood close together and surrounded the Holy

Kaabah. This imposed a limitation on streets suitable for transport (mainly by animals) in and out of the city. A conflict of interest also arose between pedestrians within the city and those entering or leaving Al-Haram. At that time, most journeys to Al-Haram were made on foot. As a result, to relieve this problem, when the Qurayash tribe ruled Makkah, after the Jurham tribe, the people began to build their houses quite close to Al Kaaba, creating a complete circle round it and streets were formed around these houses (see Fig. 2.1). The purpose of designing streets in this way was to separate the movement of pedestrians to Al-Haram from other traffic movement within the city, by keeping transport as far away as possible from Al-Haram area. To achieve this, the Qurayash tribe created two slightly wider streets, one south of Al-Haram and leading to an area of open space near it, and the other, an extension of the first street, due north and passing the eastern edge of Al-Haram. This made for easy access for caravans approaching the city of Makkah, without conflicting with local or pedestrian movement (2).

2.2.2 The Islamic Period Street Pattern

This period dates from the seventh century AD when the Prophet Mohammed arose as the Messenger of Allah (God), proclaiming the Islamic religion. The manifestation and spread of the Islamic religion led the city of Makkah to assume a new role, different from that of previous times. The city drew its importance from having Al-Haram and Al-Ka'abah, which has been

Fig.2.1



Building houses at the time of the Qurayash tribe.

Source: Author

the Kiblah (direction) to which Muslims turn, wherever they are, in their daily prayer. One of the changes which occurred in the city of Makkah was its size, due to the fact that after the Prophet Mohammed conquered the city in 9 AH 589AD), Makkah became the centre of Islam. Being the centre of Islam was the most important factor in attracting Muslims to migrate to it from other Islamic cities, in order to settle down and to perform Hajj. This caused more houses to be built within the city and therefore it increased in size. Because Al-Haram is the focal point of the city and the most significant religious centre for Muslims in the Islamic world, this attracted people to build their houses as close as they could to Al-Haram. This resulted in houses being built close together, with the effect that city roads, as previously, continued to be short and narrow. The situation created difficulty for city traffic where improvements were urgently required, not only for local transport, but also for pilgrims' caravans (3).

Makkah witnessed some improvements in its streets from time to time. In this section we will discuss the improvements made to expand and widen some roads within the city in order to solve the problem of movement for both pedestrians and trade from Hajj caravans.

In 17AH (596AD), 'Ummar, the second Khalifa (4), built the road of Al-Massaa, located north-east of Al-Haram. The purpose of creating this road was to separate the movement of people entering and leaving Al-Haram, from the main street east of Al-

Haram. This was done to prevent the mixing of trade and pilgrims' caravans with pedestrians around the Al-Haram area, and resulted in the elimination of the conflict of city traffic (see Fig. 2.2).

During 205AH (779AD), some improvements were made in roads east of Al-Haram, specifically located between Al-Haram and the Ubo-Qubys mountain. The purpose of widening its narrowest part was to smooth the passage of caravans passing northwards from the upper part of the city. The road lying next to this street and starting from the point called Ali Path, was also widened to cater for the increase of traffic movement, brought about by caravans and pedestrians, particularly during the Hajj. The route was named the Ali Path Road. The width of this road, where the valley course allowed for the expansion, was 15 metres. Also in the same year, another road was built, to the north-west of Al-Haram, running parallel with Al-Gazza Street. This road is the Al-Falg Street, which connected the north-bound road of the city with the Al-Qararah district and Al-Naga which led to Al-Haram. This road was constructed over the Al-Falg mountain. The aim of this road was to decrease and absorb the heavy traffic movement from Al-Hejoon Street to Al-Haram, especially during the Hajj. The other purpose of this road was to prevent confusion between the pedestrians and the caravans supplying food for Makkah. The road was a good alternative as it reduced congestion occurring at a point called Al-Miala district, on the main city

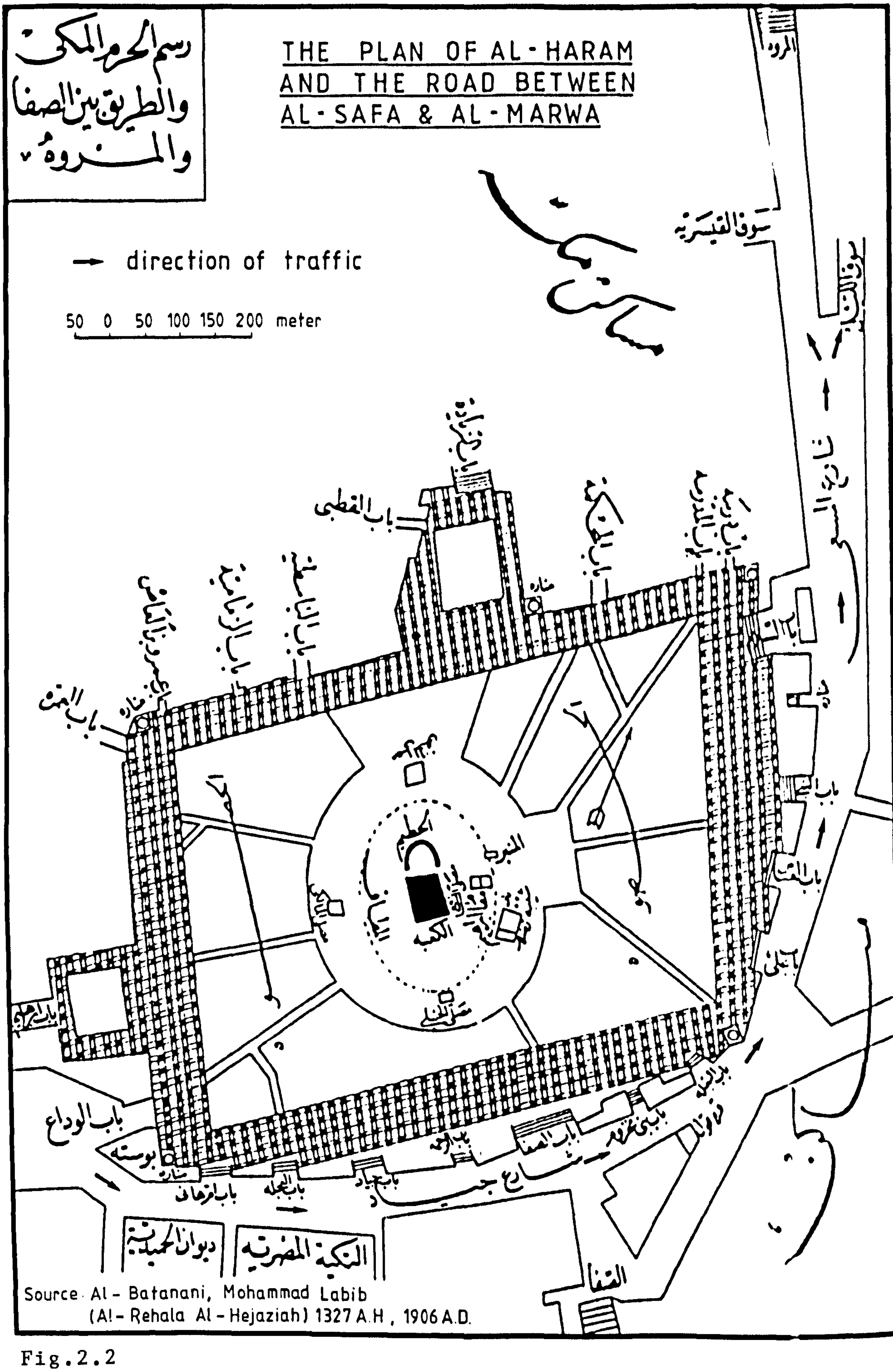

رسم الحرم المكى والطريق بين الصفا والمروه
THE PLAN OF AL-HARAM AND THE ROAD BETWEEN AL-SAFA & AL-MARWA
direction of traffic
50 0 50 100 150 200 meter
الكعبة
باب الوداع
ديوان الحميدية
التكية المصريه
الصفا
Source Al-Batanani, Mohammad Labib
(Al-Rehala Al-Hejaziah) 1327 A.H, 1906 A.D.

Fig.2.2

road, where the Halaqa wholesale market was located, which was busy at all times with shoppers (see Fig. 2.3) (5).

Makkah street patterns, after the date mentioned above, were not clear until the eighth century of the Islamic period. No data is available about improvements carried out between the second and eighth centuries of the Islamic calendar. After the eighth century, improvements were made to some city streets. This information has been obtained from one of Makkah's historians who commented about the city's street patterns. The writer, Abrahim Rifat Basha, noted:

> Most of Makkah streets are narrow and unorganised, except for one of the streets which is famous and considered the major road of the city. This street starts from Jarwal district, which lies in the south-west of Makkah (see Fig. 2.3). This road goes eastwards, crossing Harat Al-Bab in the Bab Al-Ummrah district. From this point the road shifts to Al-Qushashiah and Suk Alil road and then takes a north-east direction to the edge of the city in the Al-Malla district. The width of this street varies from eight to ten metres and even to twenty at different points. The street provides services for districts connecting with the city of Makkah.
>
> Districts which this street connects are Harat Al-Bab, Al Shubikah district, Suk Al-Sakir, Jeyad, Suk Alil, Suk Al-Safa, Al-Massaa, Al Qushashia to the right of Al-Massaa and then Al-Gaza, Suk Al-Maala, Al-Baiadiah. The road from the point called Harat Al-Bab goes west of Al-Haram and connects with Al-Shamiah district and its market and afterwards joins Al-Mudaa and Al-Judariah in the upper part of the city (6).

From the foregoing it is obvious that the width of this street was influenced by two factors, as can be seen from the map (see Fig. 2.3). These factors are: the topographic aspects, namely mountains and hills, and the intensive land use within the city, specifically around Al-Haram and the adjoining districts.

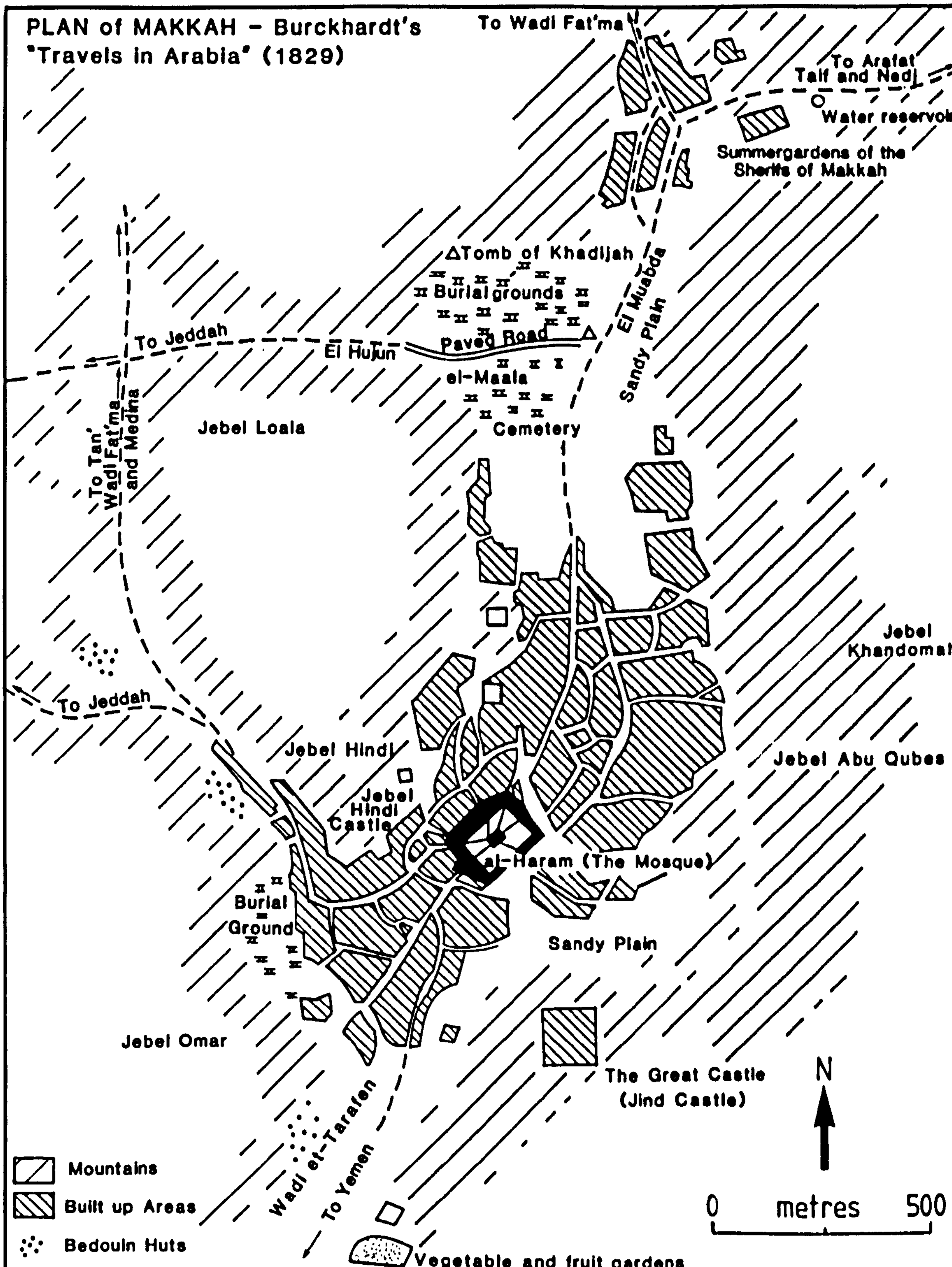

PLAN of MAKKAH - Burckhardt's "Travels in Arabia" (1829)
To Wadi Fat'ma
To Arafat Taif and Nedj
Water reservoir
Summergardens of the Sherifs of Makkah
Tomb of Khadijah
Burial grounds
Paved Road
El Hujun
To Jeddah
el-Maala
Cemetery
El Muabda
Sandy Plain
To Tan' Wadi Fat'ma and Medina
Jebel Loala
Jebel Khandomah
To Jeddah
Jebel Hindi
Jebel Hindi Castle
Jebel Abu Qubes
al-Haram (The Mosque)
Burial Ground
Sandy Plain
Jebel Omar
The Great Castle (Jind Castle)
N
Wadi et-Tarafen
To Yemen
Mountains
Built up Areas
Bedouin Huts
0 metres 500
Vegetable and fruit gardens

Fig.2.3

The street mentioned above connected with another street at the north part of the city. This street was called Al-Hejoon and was located to the north of Al-Haram and followed an east-west direction. At the eastern edge it met the major street of the city, at a point called Al-Maala, which took a north-south course (see Fig. 2.3). This road minimised the heavy traffic on the major road and was an alternative route, serving the city from the west. It was very narrow because it was constructed between two rocky hills, where trains of camels could pass through, although with great difficulty. By the year 811AH (1391AD), the Al-Hejoon road saw some improvements where it was widened to allow a train of camels to pass freely. On account of the increasing number of pilgrims to Makkah, the road became vitally important as an alternative route from the west. By 817AH (1397AD), the road had been widened again, allowing four trains of camels to travel side by side without difficulty. The importance of this road was due to the fact that the Prophet Mohammed entered the city by means of it in the year of Makkah's conquest. For this reason, most pilgrims preferred to use this route when entering the city during the Hajj, hence the need for the width of the road to be enlarged (7).

In 900AH (1480AD), various improvements were made to some streets within the city, namely the Al-Haram streets and those of the commercial area. A major factor which put pressure on improving these streets were increases, in the number of inhabitants, pilgrims and caravans.

During 1120AH (1700AD), the streets mentioned above saw some additional improvements in the removal of most of the projections, thus facilitating the flow of traffic (8).

From the foregoing, it can be concluded that ever since the time of the Prophet Abraham, until the 1950s (1376AH), land use patterns were largely subordinate to topographical features and intensive land use developed around Al-Haram and the Central Business District (C.B.D.), associated with narrow, winding streets and shortage of open space. The tendency of Makkah's citizens to build their houses very close together to make maximum use of the flat land in the vicinity of Al-Haram and the surrounding area, without paying any attention to the direction and width of streets, resulting in a narrow, twisting street network. Although street direction was often affected by the houses being close to one another, they were built like this for many reasons. Firstly, as mentioned above, people preferred to be close to Al-Haram so that they could walk there for daily prayers. This coincided with a religious concept that merit is increased by going to the mosque on foot. Secondly, the distance between houses and the main market place was kept as short as possible to minimise travelling time for transporting goods and food supplies, using manpower (porters). This closeness obviously restricted the movement of traffic, especially during the Hajj when the pilgrim caravans were hampered by houses on both sides of the street as they journeyed to the city centre.

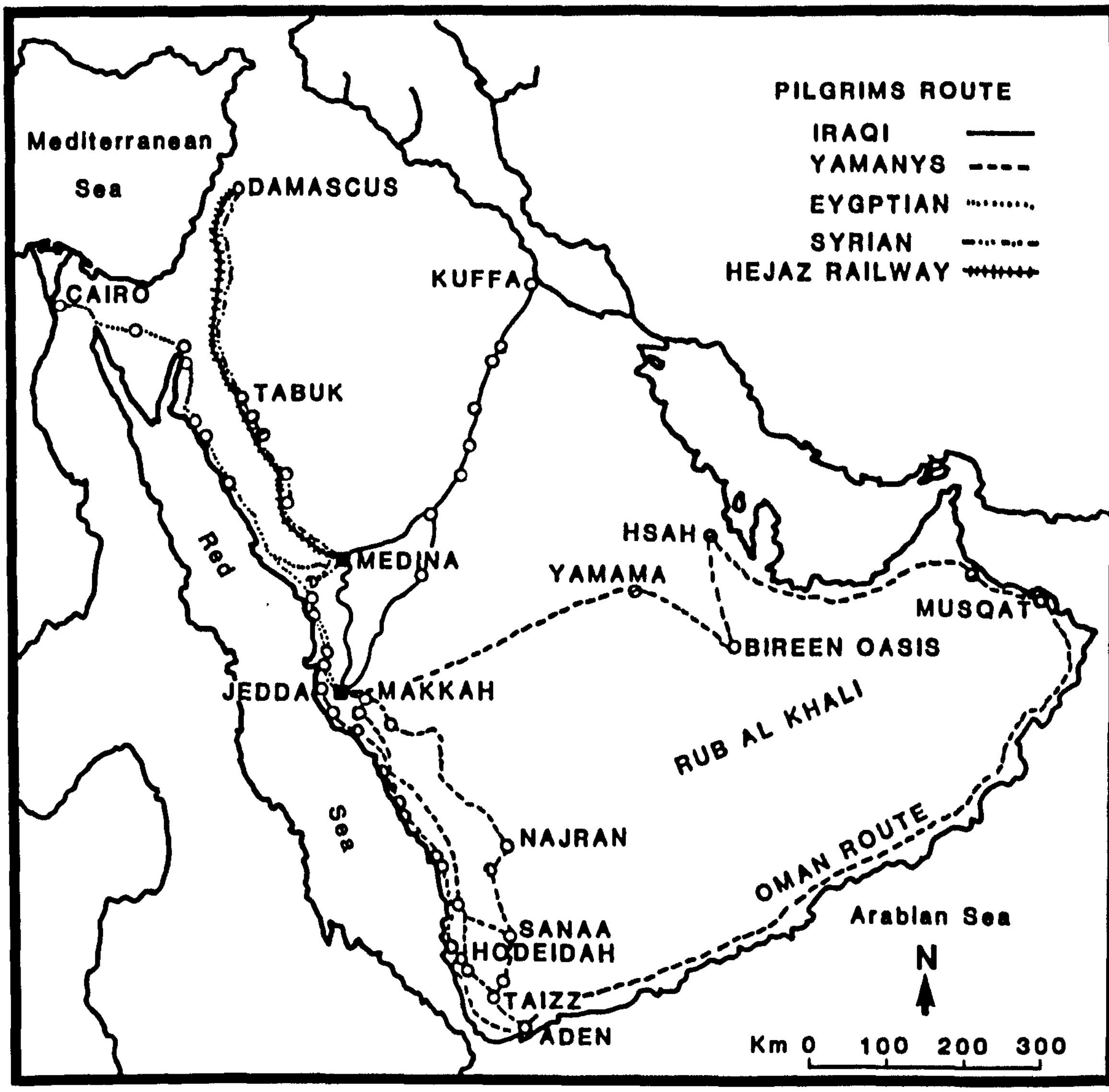
Streets were also unpaved and followed the natural terrain of the valley, which compounded the problem of movement during the rainy season, most streets being merely earth roads. Most of the early improvements to city streets comprised widening and the removal of impediments such as stones and mounds, which had been created by rain and animal movements. These changes were made in order that the roads should serve the city traffic all through the year and also the pedestrians who came to Al-Haram during the Hajj.

2.2.3 Road Patterns Connecting the City of Makkah with Other Cities

All roads leading to Makkah were historically sandy tracks which connected the city with other cities of the Arabian peninsula and other Islamic cities within the Asian continent (see Fig. 2.4) [9].

These routes through valleys and desert were hazardous. One such hazard was the problem of water supply for all caravans heading for Makkah, a journey taking from thirty to forty days. This lack of water, for both people and animals, was caused by arid wells and sometimes led to loss of life, such as happened in 851AH (1447AD), when 200 pilgrims died from thirst. During the rainy season flooding was another hazard for the caravan on its way to Makkah, destroying the road, and making passage difficult. Flooding sometimes caused the death of people, as in 990AH (1582AD), when a flood overwhelmed pilgrim caravans on their way to Makkah [10].

Fig.2.4 PILGRIM AND TRADE ROUTES TO MAKKAH



SOURCE: 1 Al-Zelail A O 1981, Makkah and its outer relations

2 Russell King, 1972, The pilgrimage to Makkah geographical and historical aspects

In spite of such problems, these routes have long been considered vital entries for trade and pilgrimage caravans to the city of Makkah. Governments have, at different times, made improvements to the routes to Makkah in order to suit them better for transportation. Governments have also tried to find alternative means of transportation to make the trip more comfortable for pilgrims and visitors travelling to the city.

At length, a new method of transportation presented itself: the train. It became necessary to consider a project to connect by train the holy cities of Makkah and Al-Medina with Damascus and Istanbul. In 1318AH (1898AD) the Ottoman Sultan Abdul Hamid revealed his desire to build the Hejaz railway. Many Islamic countries showed their response by collecting money for this significant scheme to be realised. The purpose of the project was to make pilgrims more comfortable and to relieve their travelling difficulty in using the land routes. This new method of travelling proved beneficial to the holy cities of Makkah and Al-Medina, and to pilgrims. The first train arrived at Al-Medina in 1326AH (1908AD), carrying pilgrims from Turkey, Syria, Russia and Egypt. One of the benefits of the Hejaz railway was that the journey from Damascus to Al-Medina was reduced from forty days to four. Another benefit was the reduction in the cost of travel between the two places (see Table 1). During the First World War, the Hejaz railway was destroyed north of Al-Medina and by the end of the war, the line had completely stopped (11).

Table 1 Comparative Travelling Costs by Different Means of Transport

Year AH :AD	From	To	Method	One way price	Two way price
1328:1908	Makkah	Al-Madinah and Yanboo	Caravan	£19 (2)	£38 (2)
1328:1908	Damascus	Al-Madinah	Train	£ 7 (2)	£14 (2)
1320:1904	Jeddah Makkah	Makkah Al-Maddinah and Yanboo	Caravan	£17.50 (3)	£35 (3)

1 Data taken from Siyad Abdullmajeed Bakar (Droop Al Hajej) p.176 and Abrahim Ri'ifat Basha (Miraat Al Harmeen) p.189

2 Ottoman Pound

3 Pound Sterling

Makkah benefitted economically from the Hejaz railway since trade and pilgrims were attracted to using the train to reach the city, thereby making Makkah busier than before. The destruction of the Hejaz railway, considered a great loss for both the pilgrims and the holy cities, led to the re-use of the old land routes, along with the attendant difficulties.

2.3 Methods of Transportation in Makkah (See Fig. 2.5)

Travelling between two points requires a method of transportation, the choice of which may vary according to distance. Walking is considered an acceptable mode of personal transportion over a short distance. Over greater distances alternative methods of transportation can be used in order to reduce travelling time and expenditure of energy. People faced with travelling any great distance used animals as a transportation method, mitigating the problem of having to walk. In addition, animals increased the degree of mobility. It is from this point of view that the different means of transportation in Makkah will be discussed below, with reference to transportation type, function and purpose.

The animals used for transportation were camels, horses and donkeys.

Camels were the most important means of transportation and in the last decade they were used to carry heavy loads long distances. Most of the Makkah city traders used camels to carry their merchandise from Syria (including oil, cotton, grain and leather), and gum from Yemen. Camels also carried people in general and pilgrims travelling to and from Makkah in connection with the Holy Sites of Arafat and Mina during the Hajj [12].

For the distribution of goods within the city, a faster means of conveyance was required. Horses and donkeys proved better for this purpose. As mentioned above, the city streets were narrow and winding, so horses and donkeys were considered more suited to these road conditions. They were also more useful for carrying small quantities of goods around the city centre.

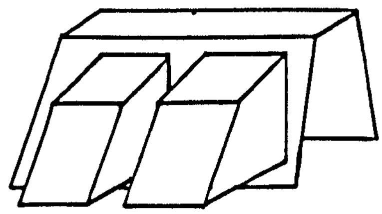
Makkah's people used horses and donkeys for many purposes, such as carrying small packages to and from the market place; carrying building materials and bricks from factories, located in the north and south of the city, to building sites; transporting water from wells and fountains outside the city to be distributed to houses inside the city (see Fig. 2.5); and for conveying people within the city [13].

2.3.1 The Early Transportational Problems in Makkah and Those Caused by Using Animals as a Means of Transportation

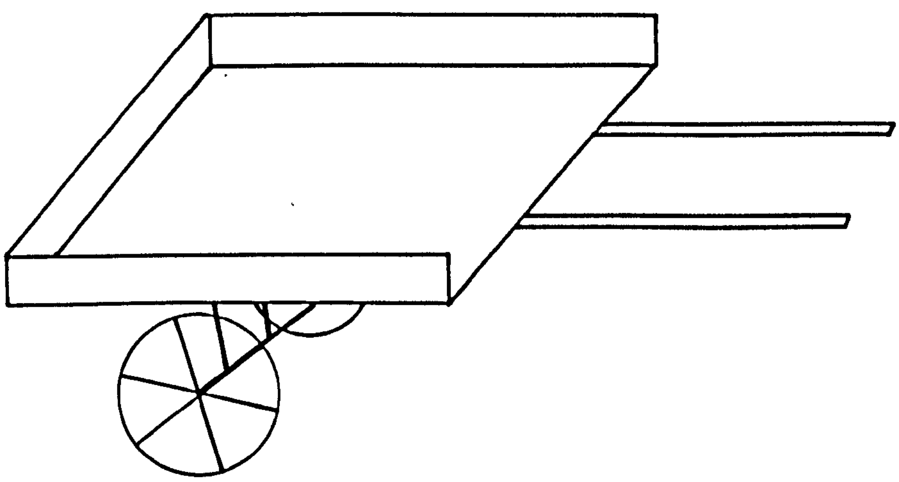
Urban transportation problems are as old as cities. One of the best examples of city transportational problems can be found in Roman cities, which had congestion, noise, dirt and odours: all problems associated with transportation. Roman authorities tried to diminish the problems by forbidding wheeled traffic from some streets, and even from the entire city during peak travelling times. This solution was necessary in order to enable city residents to get to work and do their shopping. Bazaars of Islamic cities have experienced problems similar to Roman cities, such as congestion, where pack animals, carts and pedestrians all try to use the same narrow streets [14].

It can thus be said that problems of transportation in Makkah are not unlike those in Roman cities. Fresh vegetables are brought to the people of Makkah from rural areas north of the

Fig.2.5



Container used to bring water to the city of Makkah by putting them on the backs of animals. (showing one side only)



Wagon pulled by donkeys in Makkah city in the last two decades.

Source : Author

city every day and, once inside the city, must be distributed to the urban population. This has happened in cities the world over for centuries. In addition to the movement of commodities and goods, the city of Makkah requires the movement of people. In the city there was a conflict between the movement of goods and of people. Waggons and pack animals moving materials within the city faced competition with pedestrians at the Hajj and at other times, for example, going to the shops, to work and to Al-Haram five times a day. Waggons were used in Makkah from 578AH (1158AD), but they disappeared after the introduction of motor vehicles (15).

The authorities of Makkah city also tried to alleviate the congestion problem by forbidding Hajj caravans to enter the city centre, forcing them to park in open spaces west of the city, at a point called Sydii Mahmmod (now Jarwal district and 6km from Al-Haram). On the other hand, pilgrims were allowed to enter the city on foot or riding animals such as horses or donkeys (16).

2.3.2 The Effect of Using Animals in City Streets

The streets of Makkah were considered as open roads for traffic entering or leaving the city. This was because there were no longer walls at the city's main entrances. One of these walls had been on the north-east road at a point called Al-Maala; another was west of Al-Haram at Al-Shubikah district; and the last was at Al-Missfalah district. Unfortunately, no date can be found indicating when the walls were in existence or when they were built (17).

Noise was the most common problem within the city, being caused mostly by animals on the move. Dust was an associated problem, resulting from the movement of animals on dry soil roads. The dust-laden, polluted air affected the people and also the animals' loads (often green vegetables and grain). The inhabitants tried to lessen the dust problem by watering the roads, but this was only carried out in specific areas, for example, around the market. It was impossible to water all the city streets, because water was expensive and it had to be brought some distance. Watering all streets was therefore considered wasteful of water and money.

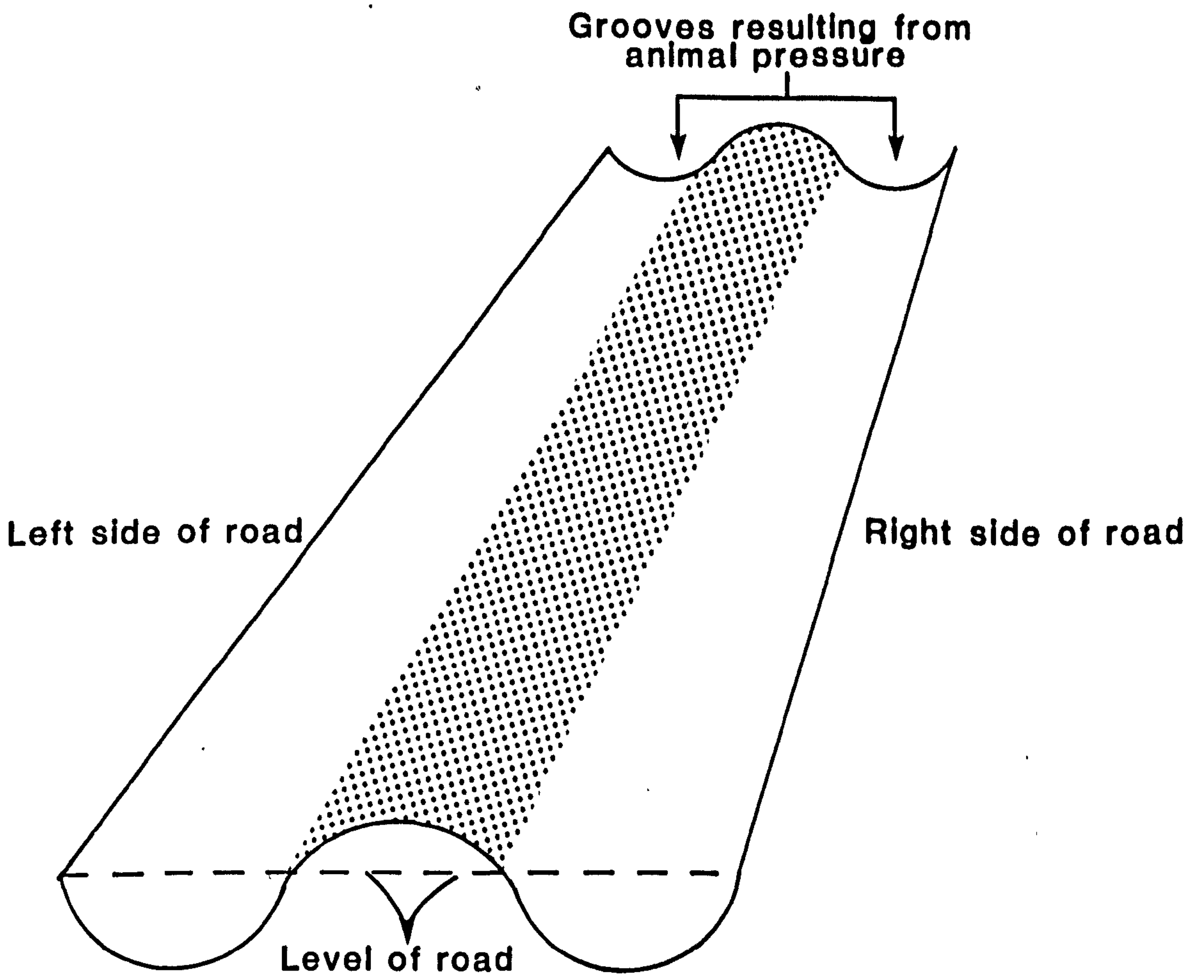
Transportation by animals caused damage to road tracks by hooves. It cost the people of the city money, energy and time to repair the roads, keeping them suitable for city traffic. Another problem for the city roads was the erosion of two parallel grooves, caused by the pressure of heavily laden animals. These grooves deepened over time, and led to restriction of city traffic and a lessening of speed and access of movement (see Fig. 2.6). The road had to be covered with soil in order to level it and make it suitable for heavy traffic (18).

2.4 The Impact of Nature on City Traffic and Roads

Makkah's location at 21°25' north of the Equator, guarantees strong sunlight and high temperatures for the city, so the weather is hot during daylight hours. Moreover, the surrounding hills and the lack of vegetation in the city reflect the sun's heat, which helps to raise the temperature to its maximum between 12.00 and 16.00 hours. Traffic movement tends to stop during this period of the day and people prefer to stay indoors. The effects of the rainy season cause considerable damage to the city roads. This is because the characteristic sandy roads rapidly become wet. When the rain continues for longer than a day, the city's roads are turned to mud, with mud and stones being brought down from adjacent hills and valleys. The result of this is that city traffic slows down for a few days and people cannot move around easily. Even waggons and pack animals become inactive until roads return to normal. Once the mud has dried it then has to be removed and the roads levelled, thus clearing the city streets for traffic. This matter will be further discussed later.

Regardless of all the difficulties which faced the old method of transportation serving the city, it was vital to use these sandy roads, due to the increase in the size of trade in Makkah (18). It can be deduced from the size of trade that there was an increase in the city's population. It can also be deduced that the demand for keeping roads in good condition encouraged Makkah's authorities to improve them, allocating special funds to keep them serviceable for city traffic.

Fig.2.6



Grooves caused by using the old method of transportation in Makkah.

Source: Author

2.5 Advent of Motor Vehicles in Makkah

Cars were unknown in Makkah city before 1340AH (1920AD), after which the city witnessed the arrival of the first car, which belonged to Al-Sharif Al Hussen Ibu Ali, the ruler of Makkah at that time. The Sharif rarely used his car, because the narrow roads within the city were unsuitable for motor vehicles, which required wider and more level roads.

The city road conditions could not cope with the new method of transportation because they were unpaved and needed to be redesigned in order to keep up with transport development.

Makkah witnessed a construction development when King Abdulaziz ruled Al-Hejaz region in the year 1343AH (1923AD). The improvements led to an increase in the number of cars within the cities of Makkah, Jeddah and Al-Medina. Saudi companies were established to import automobiles to those cities [19].

2.5.1 City Problems in the Automobile Era

Makkah has long been an important focus for transport and, as mentioned above, the city was, and still is, the focal point for roads which connect the city with Hejaz region, Arabian peninsula cities and other Islamic cities. Also, as mentioned before, the method of transportation used to carry loads to Makkah was by animal, especially camels where heavy loads were involved. At the outskirts of the city, wherever space could be found, the camels were forced to park with their loads. Animals such as donkeys were then laden with small loads for distribution within the city. Since vehicles presented great problems to Makkah, this mode of transportation was in keeping with the alleys and narrow streets which were only suitable for pedestrian traffic. These problems will be discussed in the following sections.

2.5.1.1 Problems Associated with Using Automobiles

A feature which attracts attention in Makkah and specifically the Haram area is the high density of buildings. This is a result of the preference to be near the holy Kabaa for religious and commercial reasons. All available space was used for development which caused the associated problem of narrow streets. The climate contributed towards the style of building with narrow alleys in order to provide shade for the pedestrians, thereby keeping them cool as they walked about the city [20].

On account of the narrow streets and unpaved roads, cars could not enter the city. The narrow streets prevented large lorries from delivering goods to small shops in the city centre. The city authorities tried to alleviate this problem by making van services stop at an open area to unload, transferring their merchandise to animals or men for distribution to shops and consumers. One example of these open spaces was in the southern part of the city, at a point called Jarawal district; another area was located in the northern sector, between Al-Mabada and Al-Maala districts (see Plate 1). Both these areas were large enough to allow easy access for several cars. Since the streets were so narrow and twisted not even a single car could pass along without risking damage to itself and to the houses. The streets were incapable of dealing with the demands of city traffic. Door to door journeys were impossible within the city, especially for those whose houses were built on hills. In the latter case, part of the journey to their destination had to be made on foot, due to the fact that roads leading to hillside dwellings were constructed in steps, rendering them useless for cars. Such flights of steps still exist (see Plate 2). A major problem connected with the narrowness of the streets was that fire engines were unable to stop in an open space, pulling hoses some 60 metres or more to extinguish the flames. The same problem was faced by an ambulance taking a patient from the scene of an accident. The outcome was often loss of life and property.

As a result of streets being narrow and unpaved, traffic speed was slow and cars had to swerve constantly to avoid stones, rocks, etc. which could cause severe damage to vehicles. Animals and cars travelled side by side on the narrow city streets, causing further restrictions. Drivers found it difficult not to collide with animals in their way and also had to keep to a minimum speed when travelling behind animals. This situation led to delay, congestion, and accidents because the roads were not wide enough to allow cars and waggons to pass one another [21].

منظر رقم ٧٣

بعض الجمال الباركة بأحد شوارع مكة فوق المعلا وبجوارها السيارات

Plate 2.1 Former parking place for transfer of goods from vehicles to animals in northern Makkah (about 1950). Animal transport was necessary to negotiate narrow streets in the city centre.
Source: Taher Al-Kurdy (1965).

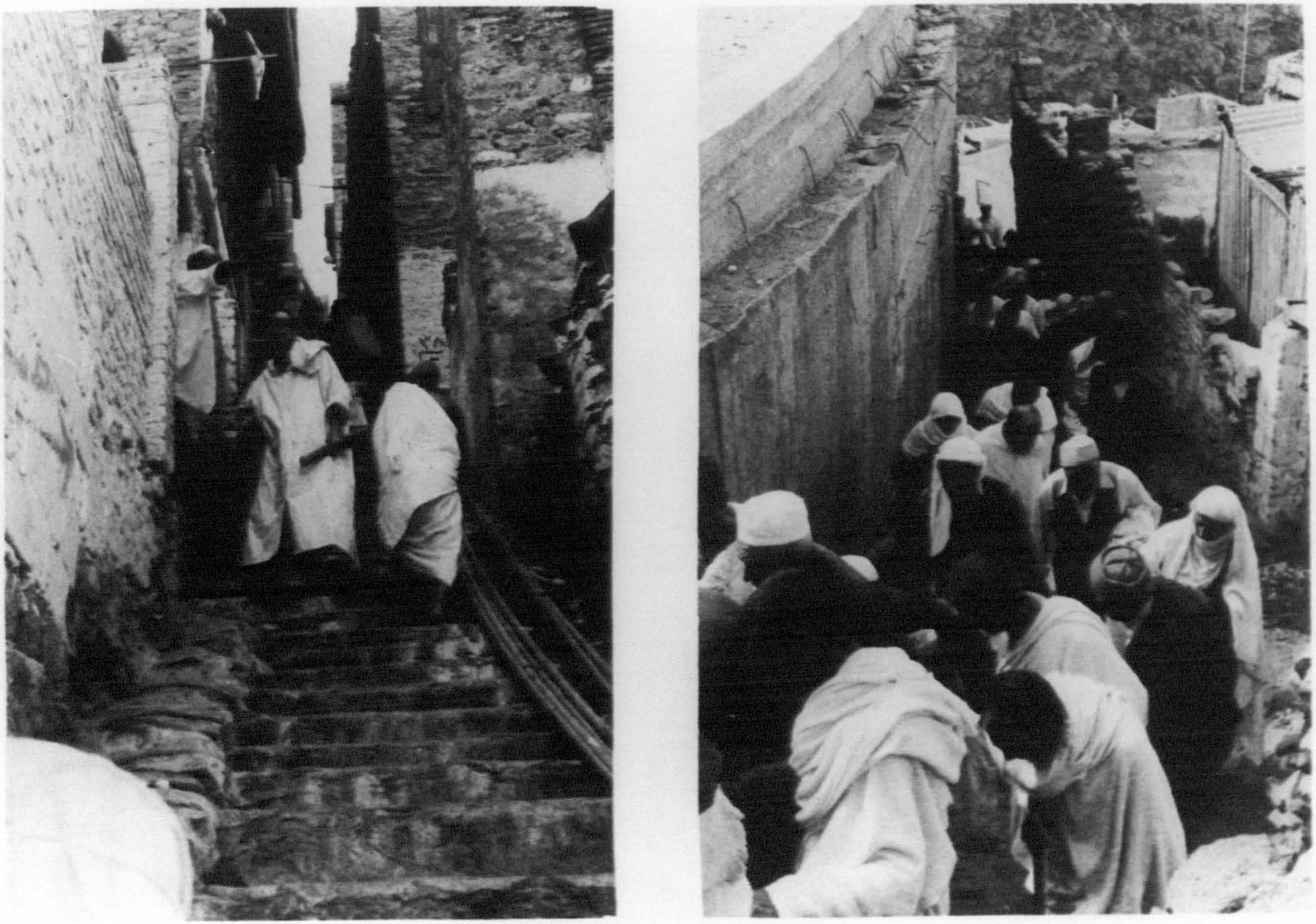


Plate 2.2 Problems of pedestrian access in central Makkah;narrow passageways and steps near AL-Haram(about 1975).
Source:Gahazy Mecci(1977)

2.5.1.2 Problems Caused at the Time of Increasing Use of Automobiles

Many people in Makkah were hesitant about using motor vehicles instead of animals because they thought using animals or walking was healthier than driving a car, which was considered an uncomfortable method of transportation. However, the suspicion of using cars was quickly overcome when people realised the advantages of using a car: reduction of journey time and the ability of a car to transport passengers and heavy loads, which animal transport lacked [22]. Thus the people of Makkah became familiar with driving vehicles and the incidence of car ownership grew gradually among the citizens.

The most prevalent problem arising from the increase in the number of cars in Makkah was and still is that of parking. The high density of buildings and the development of every vacant space around the holy mosque and the area adjacent to it contributed to the limited area of open space. The lack of parking space created difficulties which had not previously been encountered. The people tried to park in every available space within the city because it was impossible to erect garages next to the houses around Al-Haram or in districts near to it, and the area was crowded with pilgrims during the Hajj. Car parking problems were common around Al-Haram, for example, in the Al-Shamiah district west of Al-Haram and the Shaib Ali district east of Al-Haram. People of the Al-Shamiah district had to park their cars at Bab Al-Ummra, south of Al-Shamiah, where there was enough space to park ten or fifteen cars overnight. The inhabitants of Shaib Ali were obliged to leave their vehicles at a point between this district and the Shaib Amir district. This problem is not confined to the areas mentioned above, but also to other sectors of the city of Makkah. The problem of residential parking will be discussed in one of the following Chapters. Another problem accompanying the introduction of motor vehicles was noise. Driving cars on unpaved roads full of bumps and potholes made a lot of noise by day and night, which was troublesome to residents. In addition, driving over unpaved roads raised dust, causing health problems due to the inhalation of the dust and exhaust fumes. Accidents had been uncommon during the time of animal transport, but the increased use of cars incurred some dreadful accidents. This aspect will be discussed later [23].

However, despite the difficulties brought about by the introduction of cars, motor vehicles brought with them such benefits as greater accessibility to distant places and new job opportunities for the people of Makkah.

The introduction of long buses and lorries, used to transport pilgrims and their luggage, aggravated the city traffic problem. It became impossible to drive through the narrow and winding streets to take pilgrims to and from their accommodation near Al-Haram. This increased the pressure on the need to improve the condition of the city roads.

2.6 Recent Street Patterns in Makkah

Since the time of the Saudi government (1343AH, 1923AD), and with the discovery of oil, Makkah has expanded as rapidly as any city in the Kingdom of Saudi Arabia. The city has seen a tremendous era of expansion and development. Exploration for, and discovery of, oil in Saudi Arabia has influenced the economy and the social life. This has brought power and an increase in the use of cars. However, cars are of little use without paved roads. In response, the Saudi government realised the importance of road development and has given priority to road construction between and within cities. Makkah's development is one of the main aims of the Saudi government, and the city has gradually acquired more wide and well organised streets in an attempt to keep pace with the new method of transportation and to ease congestion during, and outside, the period of Hajj.

2.6.1 Street Patterns in the Early 1950s

Until the early 1950s the only significantly wide street through Makkah followed the direction of the natural water course of the valley (Abrahim valley), cutting the city from north-east to south (see Fig. 2.7). From the north this street ran its course through busy, crowded quarters and sub-quarters such as Al M'abdah and Al Kariq. At this point the street branched into two: one way taking a south-westerly direction, passing Al Sulimaniah and Al Falg quarters through the hills to Al Shariah, connecting with Al-Qurarah and then to Al Shabikah quarter. The

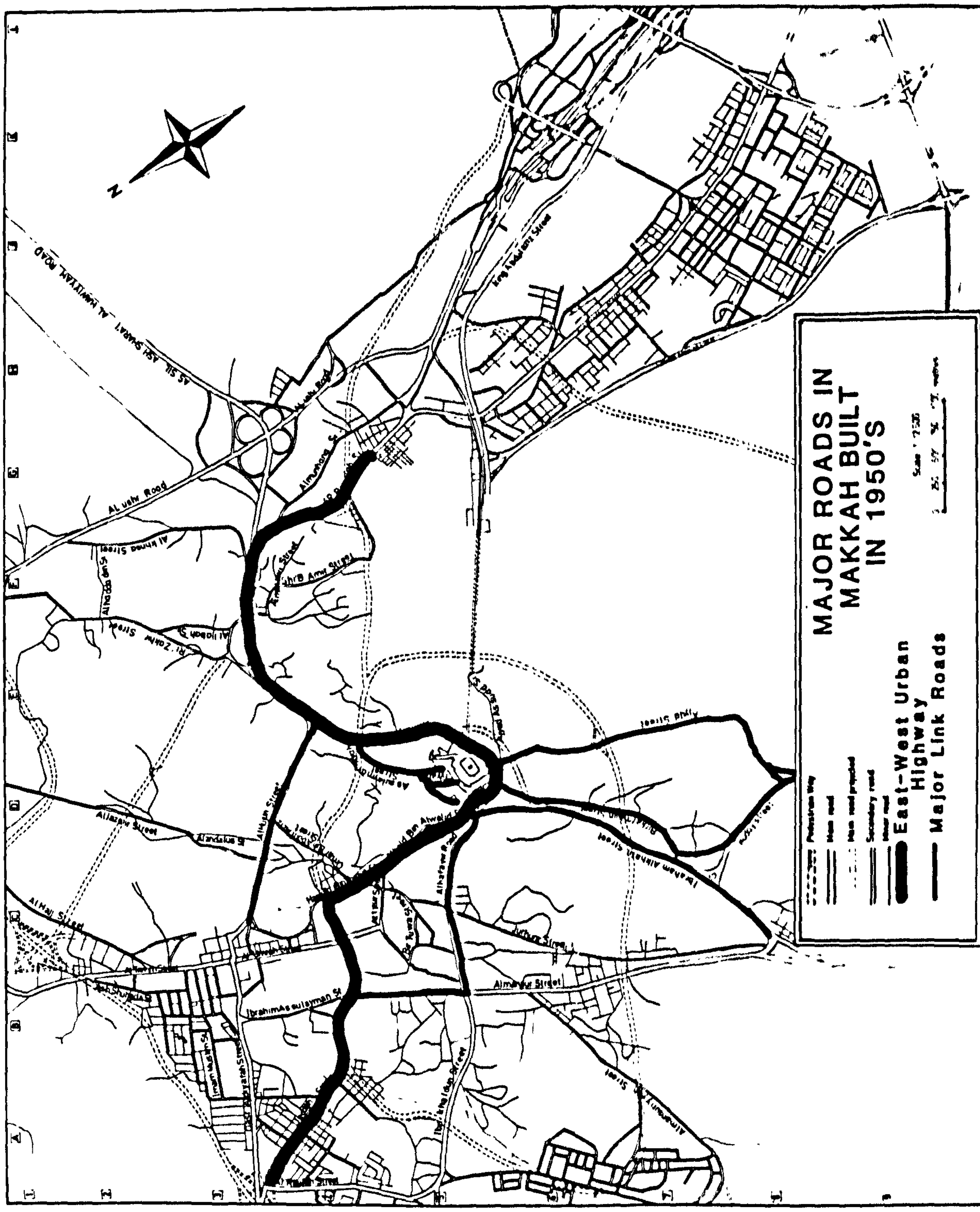

MAJOR ROADS IN MAKKAH BUILT IN 1950'S
East-West Urban Highway
Major Link Roads
Al Hajj Street
Almansur Street
Al Ushr Road

Fig.2.7

other way took a southerly direction, where the street still runs with the natural water course of the valley, passing Al-Gazzah, Suk Al Lail and Al-Qushasihiah, and from here turned around the eastern side of Al-Haram to pass through Suk Al-Sakir; here the street divided into two branches, south to Al-Missfalah and the other went west, joining the south-westerly road passing Al Shabaikah to Harat Al-Bab and then Jarwal district to the west. From here the road continued to Jeddah. Due to topographic barriers there was no easy alternative route and this street was the only one leading in and out of the city from north and west, beside the southern branch which led in and out of the city to the Al Yemen road. This street was extremely busy at all times; it became jammed with motor vehicles and pedestrians during and outside the period of Hajj. Shops were situated on both sides of the road and the shoppers intermingled with the motor vehicles, causing obstruction to the people and delay to the movement of traffic. The problems of congestion on this street doubled in time and required an urgent solution. The government of Saudi Arabia decided to widen its narrowest sections to ease the pressure. A project was begun in 1955 to enlarge Al-Haram as part of an overall programme of improving the old quarter of the city, specifically changing and improving street siting, intended as an accompaniment to the national revival in Saudi Arabia. The roads of the city were asphalted and for the first time pavements were constructed on both sides of the road in order to separate pedestrians from motor vehicles, thereby avoiding accidents which were caused by the confusion created by people crossing or walking in the middle of the road.

Under the project for the improvement of the city network, six new side streets were opened which led in different directions (see Fig. 2.7). These six branches connected with the main street, mentioned previously, and led to the city centre at Al-Haram. The new streets made the central area and Al-Haram more easily accessible for people coming from other districts. However, they also created pressure on the central region and Al-Haram square, where people usually went five times a day for prayer. Also, large numbers of people entering the city for Friday prayer parked their cars around Al-Haram, causing congestion and obstructing traffic passing through Al-Haram. The same situation occurred in the Central Business District (C.B.D.) where the main market place was located, north-east of Al-Haram. The market place area was fully occupied by cars during the weekends because they were used for shopping purposes. This also led to further congestion for city traffic. The first of the streets which connected with the main one was Al-Hejoon and Al-Utaibiyah, which ran from west to east to serve Al-Utibiah and Al Zaher districts. This road joined the main street at Al-Maala. The second street came from Al-Kariq, linking four quarters with the main street. These quarters were Al-Sulaimaniyah, Al-Naga, Al-Shamiah and Al-Qararah. This road joined the main street again at Al-Shamiah district. The third road came from Al-Gazzah square, through the back of Suk El-Lail and Al-Qushashiyah quarter, following the eastern edge of Al-Haram and joined the main road down at Jeyad square. The route from Al-Gazzah to Al-Qushashiah quarter formed a bottle-neck because of its location between Al-Haram and Abu-Qubies mountain. The branch street went to the end of Jeyad square, through Bakhash mountain, leading to the east of Al-Haram area. This took a southerly direction to Kudy square and connected the main street with road number one, which led to the Holy Sites. It ran parallel to Al-Missfalah street, so that it reduced congestion on Al-Missfalah street during the day and became widely accepted by drivers as an alternative route to Al-Haram sector. The fifth road passed Al Shubaikah square, leading to the west through Al-Hafayer mountain and joined part of Jarwal street, Al-Tundubawi, Al-Mansoor street and Al-Hindawiyah to the city centre, and on to the old Jeddah road. The sixth and last ran through Al-Kaaba mountain, taking a north to south direction. This road was parallel to Harat Al-Bab street and led to Jarwal district from Al-Haram as an alternative to using Al-Shubikah street. In addition to that, it had a branch which led to Al-Hafayer street, taking a westerly direction and joining the other side of Al-Hafayer road, leading to Al-Haram and Al Missfalah, running south [(24)].

From the foregoing it can be deduced that most of the streets led to the Al-Haram locality, through which most journeys within the city had to pass in order to reach other parts of Makkah. Also, cars travelling from beyond the city put great pressure on Al-Haram region since they had to cross this area in order to reach other cities, such as Jeddah and Taif. There was no way of avoiding the city centre. This required urgent action in the form of improvements to relieve congestion and to develop the city network to separate the flow coming from Jeddah or Taif and the local traffic, and also to alleviate the pressure on the Haram area. In addition to this, it was necessary to develop the urban network to make it more effective by providing direct connections between city centres and to meet the growing traffic demand associated with the increasing number of cars in the city. The number rose from 11,900 in 1970 to 100,516 in 1981 [(25)]. The increase in car ownership was related to economic development in Saudi Arabia.

2.7 The Development of the Makkah Network

As mentioned above, the city of Makkah formed the focal point for regional trade and pilgrim caravans, all using the primary unpaved roads which extended to national and international networks. Also, as mentioned before, there were hazards and difficulties associated with this network which followed the natural valley course, since no alternative routes were available. As a result, governments over the decades have endeavoured to improve conditions for road travel to and within Makkah. Since the time of Saudi government, road-building has witnessed a golden age and by 1953 the total length of roads constructed within the Kingdom was about 239km. Once the Kingdom of Saudi Arabia had been established as one of the world's oil exporting countries, economic development within the country was hastened. This helped the government to concentrate on the construction of road networks to join the country's cities and the improvement of cities' local roads. By the end of the second development plan (1975-1980) the total of completed roads was 13,066km for main, secondary and paved feeder roads and 10,250km for earth-surfaced rural roads which increased the length of the Saudi Kingdom network to more than 23,000km, connecting the main cities and rural areas of the country [26].

Makkah has benefitted from the flourishing economy of Saudi Arabia. The city witnessed great and rapid expansion in 1370AH (1970AD), which was when the Saudi government adopted development policies and programmes which greatly influenced all aspects of economic and social life. One of the significant changes was the popularity and rapid increase in availability of the automobile. Increased mobility gave people the freedom to build houses further from the city centre resulting in a drastic morphological change in city development. The city therefore expanded very rapidly, which led to an increase in road construction in order to make the newly developed areas accessible. Now, the limits of the city were no longer determined by walking distance.

As mentioned in Chapter 1, topographical aspects have influenced the shape and form of the city streets which followed the natural course of the valley, leading to Al-Haram area and the C.B.D.. The city districts had also been developed over the years which increased the overall size of the city and incurred the lengthening of roads. However, the development was random and city planners payed insufficient attention to road widths. Eventually, existing streets were widened and new streets were constructed. These improvements occurred after the Saudi government adopted a new development strategy in 1980 [27]. The network started taking a new technological form by crossing the valley and connecting other city roads by means of loop-shaped junctions, bridges, tunnels and ring roads. These will be discussed in greater detail. The present Makkah network can be classified as major primary roads, urban roads and side roads. The major roads all lead to the Al-Haram area from the outskirts of the city, while ring roads attract traffic travelling to different parts of the city without passing through the centre (see Fig. 2.8).

2.7.1 Makkah Roads

The road system included major primary arterial roads, connecting the city of Makkah with other cities of the Kingdom. These roads carry a high proportion of the traffic. The urban roads serve the city traffic and are connected with the major primary roads to provide a link between roads within the city and those outside it. Through this network, the people of Makkah are now able to travel more easily to other Saudi cities.

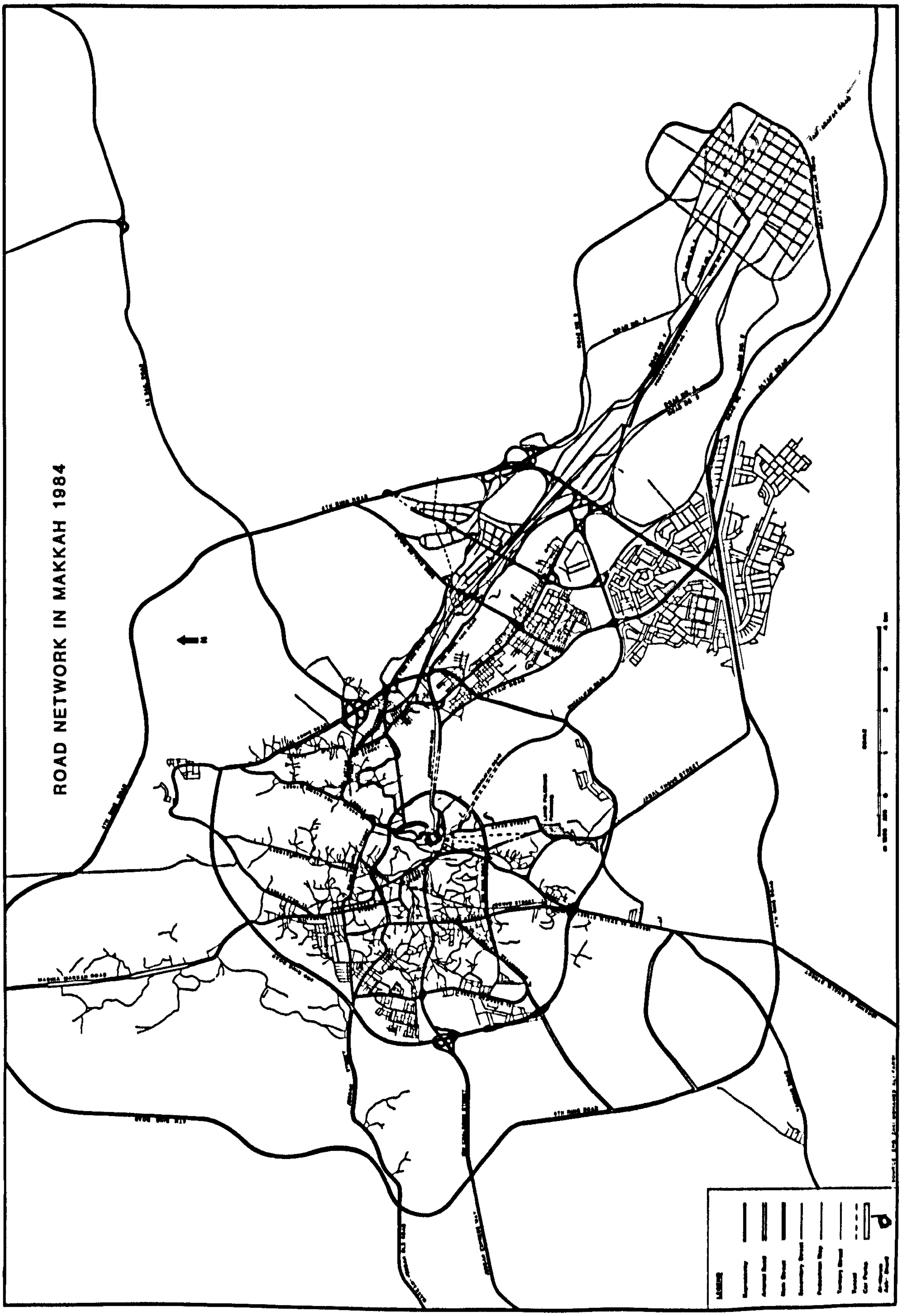


Fig.2.8

2.7.2 Major Primary Roads

The area covered by the Makkah network consists of six major roads converging on the city. These roads are very busy during the Hajj and to a somewhat lesser extent during Ramadan and other months with religious, personal or other special significance. The roads will be discussed from the point of view of their function, characteristics and importance to the city.

2.7.2.1 Old Jeddah-Makkah Road

This road is located to the west of the city and connects it with Jeddah and its airport and seaport. Jeddah is the main gateway to the city of Makkah during the Hajj and throughout the year for pilgrims and visitors. Makkah does not have its own airport because the complex land relief does not provide a large enough flat area. On the other hand, the city has a seaport, although it is not very suitable for sea traffic because it is full of coral reefs and therefore very dangerous for shipping. Another disadvantage of the seaport is its distance from the city, which is about 95km, further than that between Makkah and Jeddah which is 75km.

A traffic survey held in 1971 for the old Makkah-Jeddah road showed that the road from Makkah to Jeddah is used to about 20% of its practical capacity at normal times of the year, with a rise to 89% during the Hajj. This survey concluded that by 1990 the growth of traffic along this road and other routes to the city will be very substantial, since a six-fold increase in non-

Hajj traffic seems likely between Makkah and Jeddah and a five-fold increase between Makkah and Al-Medina. It was recommended that a new dual carriageway three-lane motorway be built between Jeddah and Makkah to meet future traffic demands between the two cities [28].

2.7.2.2 Jeddah/Makkah Expressway

As recommended by the planner, Robert Matthew, the building of this road to meet the future traffic demand between the two cities was started in 1978 and completed in 1981. The length of the completed road is 64km, which is shorter than the old road [29]. The road runs parallel with the old one, but reduces the distance between Makkah and Jeddah by 10km. The expressway has four lanes in each direction and on approaching Makkah becomes three-lane. The right-hand lane is specifically for freight vehicles and buses, the remaining lanes being for all other types of motor vehicle.

The road provides direct access to Makkah for pilgrims coming from Jeddah's Islamic seaport. It also plays a significant role as the main arterial road for pilgrims travelling from abroad, as it connects directly with King Abdulaziz airport in Jeddah. The expressway separates the Hajj traffic and the city of Jeddah traffic, so that pilgrims can be transported quickly to Makkah without difficulty.

The road carries heavy traffic during the weekends [30], due to the religious significance of Makkah and the fact that visitors tend to travel to the city on Thursdays and Fridays for Friday prayer and to perform Ummra (little Hajj).

2.7.2.3 Makkah/Al-Medina Expressway

This road is considered as an essential expressway and will play a significant role in Saudi Arabia, linking three important seaports, Al Jubeel, Damam, Jeddah and Yunbaa. In addition to this, the road provides a potential service for traffic flow between Makkah and Al-Medina. It also makes travelling comfortable for pilgrims and visitors travelling between the two cities during and outside the Hajj period. Construction of this road started in 1404AH (1981AD), and was completed by the beginning of the second half of 1405AH (1985AD). The length is 420km, which is about 40km shorter than the original road. It consists of six lanes in total, with three lanes 11.5 metres in width, each way. The central reservation is 20 metres wide in order to minimise the risk of accidents and headlight dazzle at night [31].

2.7.2.4 Makkah/Taif Roads

Makkah is linked with Taif city by two roads, one taking an easterly direction and the other taking a north-easterly one. The road to the east is called Makkah-Al Kur road and the other is called Makkah-Asisail expressway. In this section we will discuss these two roads separately, with data obtained from government offices and a survey made on a fieldwork visit in February-July 1985.

The first road starts from south-east of Al-Aziziah district and goes eastwards in the direction of Taif, and ends at Al-Kur mosque, where the winding road leading to Al-Hada and Taif starts. The length of the road is 37km, and it passes through the Al-Nama'an valley, spanning it with many bridges, thereby ensuring that the natural passage of water is not impeded. The road has three lanes in each direction with a median 20 metres in width. At one point it crosses a road which is allocated for non-Muslims. The road was proposed during a project established in 1978 and the work was completed in 1980. The road is vital as it ensures rapid traffic movement for vehicles going from Makkah to Taif, without passing through the Holy Sites in Mina, Mizdalafa and Arafat. This is the purpose of the road [32]. From Al-Kur mosque, the road starts crossing the Al-Hadah mountains for a distance of 40km, having one wide lane (about 5 metres) in each direction. This road not only serves the pilgrims who use it to reach the city of Makkah during the Hajj and for daily trips between the two cities, but also forms a good link between the agricultural area in Taif city and Makkah. The city of Al-Taif provides Makkah with fresh food, poultry and fruit daily.

The second road starts north-east of Al-Faisallyah district and goes eastwards with a slight northerly slant towards Taif. The length of this road is about 95km, and it passes Al-Zimah and Al-Sharaia, serving the residents and transporting agricultural products from these two villages to Makkah. The road has three lanes in each direction, with a concrete partition half a metre wide and a metre high separating the two carriageways. This road is important because traffic can travel at speed when coming to Makkah via Taif from Riyadh and the northern cities of Saudi Arabia at the time of Hajj. This was an alternative route for pilgrims who did not wish to use the Al-Medina expressway. A great volume of traffic passes along this road, much of it in the form of long lorries carrying food supplies such as grain and flour to Taif. It is easier for trucks to use this route rather than the Al-Hadah mountain road when travelling to Taif. It links with the airport of Taif and goes through As-Sail valley, using bridges to cross wadis so that the road is not damaged in floods [33].

2.7.2.5 Makkah/Al-Lith Road

This road starts from the south at Al-Kaakiah district and goes to the south in the direction of Jazan, passing Al-Lith and Al-Qunfadah to south Yemen. This is classified as a two-way road since it has a lane in each direction, each being about 5 metres wide with no central reservation. It is linked with the Jeddah/Makkah expressway in the south-west at Al-Shumessy and with the Makkah/Taif motorway. This saves the urban roads of Makkah from being affected by the heavy freight trucks journeying to the cities of Taif and Jazan. The road provides access not only for freight trucks, but also for passengers who want to travel directly between Jeddah and Taif without passing through

Makkah. As a result of this connection the traffic volume and associated congestion were reduced because those travelling to Makkah did not use this route. The road provides services for pilgrims from North and South Yemen cities located on the way to Jazan within the country. This route carries heavy traffic during the Hajj since most of Yemen's pilgrims prefer driving to Makkah by car [34].

The traffic volume varies on major primary roads leaving and entering the city during and outside the period of Hajj. This aspect is discussed below.

2.8 Makkah Urban Road Network

As mentioned above, the growth of the city and the road network within the holy city has been determined by the mountainous terrain. The consequent relatively high density development and compact urban area are reflected in the normal peak-period traffic demands made by 301,000 permanent residents, and the character of the built-up area creates significant constraints on major improvements on existing roads and the construction of new highways. By 1991, the volume of traffic on roads within the holy city is anticipated to increase six-fold for a low population projection of 550,000 (already exceeded) and a ten-fold for a high population projection of 950,000 (see Table 2). This creates a great demand for new routes, while taking into account the existing network [35].

Table 2 Peak Period Passenger Car Traffic

(Total peak hour trips)

		Projected	
	1971	1991 (low)	1991 (high)
Internal Traffic	14,140	87,690	151,690
External Traffic	1,340	5,080	5,690
Total Traffic	15,480	92,770	157,360

Source: Master Plan Report, Makkah p.102

Some major improvements have already been made towards developing the city network. In this section we will discuss the present urban network in Makkah, which can be classified into Arterial Roads, Main Streets, Secondary Streets and Tertiary Streets. The arterial road system connects the major primary roads leading into and out of Makkah. A main street system connects with the arterial road network and the secondary street system connects with main streets. In addition to this, tertiary streets connect with main and secondary streets. This network makes the city streets more able to meet the demands made by increased movement of residents on normal days and also enables Makkah to meet the needs of pilgrims and visitors during and outside the period of Hajj.

2.8.1 Arterial Roads

This type of road system plays a vital role in the city network. It consists of four ring roads, providing easier access and a faster flow of traffic to the fringe of the urban area, where it plays a significant part as a distribution, radial and collection route. This system contributes towards reducing congestion and provides a direct link between the districts, decreasing the time taken for a journey. Originally a trip from Al-Haram to Al-Aziziah took more than 35 minutes, but now takes 10 minutes, due to one of the ring road tunnels which bypasses many districts. The construction of ring roads has been going on since 1400AH (1980AD) and, although a few have yet to be constructed, the majority have now been completed . When the ring roads have been completed there will be less congestion and faster traffic movement within the city.

2.8.1.1 The Haram Ring Road

This road forms a semi-circle around Al-Haram area. The work started in 1400AH (1980AD) as the result of a project. The first and second sections have been completed and in use since 1402AH (1982AD). The first part connects Al-Mesial and Abrahim Al-Khalil street with Jeyad street. From this point, the road continues to Barahat Al-Taffran, north of Jeyad takes a northerly direction through tunnels to connect Jeyad and Barahat Al-Taffran with Al-Qushashiah, ending at Ali Path. The road is 1140 metres long, with two lanes in each direction, about 12 metres wide.

The work now in progress will complete this circular road, connecting Al-Qushashiah at Robaa At-Tlaa to Barahat Al-Rashidi in Shaib Amir, joining at Al-Haram street. Most of the houses were demolished to complete this section and where this occurred it cost the government S.R. (Saudi Riyal) 451,921,237 (equal to £2327.8 million). This part will be paved in the near future. Work has also started on connecting Al-Qushashiah with Jabal Al-Kaaba street through the Jabal Quigaan tunnels which are west of Al-Haram. The cost of constructing this portion of the road is S.R. 28 million (£144 million).

The other section, which will make this road a complete circle, will be considered after establishing the budget needed to finish the road. The parts needing to be connected are Shaib Amir to Al-Shamiah street, which will lead to Jabaal Al Kaaba street, and from this point to Galat Ajeyad tunnels and continuing west, passing Jabal Harat Al-Saddah to Khaldon street and Al-Hafayer mountain. From this point the road will take a southerly direction to Dahalat Al-Rushad at Al-Misfalah district and 'Ummar mountain, finally joining Abrahim Al-Khalil street at the starting point of the road. Considerable attention has been paid to connecting this road with all district roads around Al-Haram [36].

The objectives in building this road are several: to reduce traffic congestion around Al-Haram; to speed the traffic movement; to separate pedestrians from the vehicles near Al-Haram in order to avoid hold-ups at the time of daily prayer; and to make it easier to travel to and from different ditstricts without crossing Al-Haram (37).

2.8.1.2 Inner Ring Road

This road consists of a semi-circle surrounding the central area, about 1.5km from Al-Haram. It is approximately 9km long with three lanes in each direction and seven intersections serving its connections with main streets. The road has four dual tunnels of 5km in length and the section located at the tunnels on the inner ring road is 2.5km. It was designed to eliminate traffic congestion around Al-Haram, which is over-crowded with visitors intending to go to the mosque (38).

2.8.1.3 Central Ring Road

This road forms a complete circle round Makkah. It is approximately 28km long, with some tunnels cut through the mountains surrounding Makkah. It is about 4km or 5km away from the Haram region. The central ring road consists of three lanes in each direction and has several interchanges to provide links with major primary roads leading to Al-Medina road, Jeddah old road, Jeddah expressway, Al-Lith road, Road No. 1 leading to Arafat, Kudi road which connects with the Ajeyad Kudi tunnels and Makkah Al-Aushar road. It also crosses the road coming from Mina. The central ring road and its connections with major roads provides convenient access for traffic to Al-Haram and to other cities. In 1402AH, 1982AD, construction of the south-west side of the road was started, at a point called Al-Rusifah. The work was finished in 1983 and this section connects Jeddah expressway with the Kudi road. The road is of great benefit since it carries the pilgrims coming from Jeddah to visit Holy Sites, without entering the centre of Makkah (39).

2.8.1.4 Outer Ring Road

The outer ring road forms a circle round Makkah. It is approximately 57km long, but the actual constructed length is 12km, starting from a point on Al Taif road between Al Adel district and Al-Sharia village. From here, the road follows a northerly direction to meet Road No. 1 south of Mizdalifah, leading to the north and south of Mizdalifah over two parallel bridges 2.5km long, having four lanes in each direction and being 15 metres wide. The road provides easy access to Arafat and assists the flow of traffic in both directions since it passes under the bridges already mentioned above and connects Arafat with Mina. The section of road from Al Taif road to Mizdalifah cost S.R. 400 million (equal to £2,060 million). The part yet to be completed is estimated to cost S.R. 90 million (equal to £464 million) (40).

2.9 The City Main Streets

This system consists of a network of the major city roads which eventually links up with the city centre and Al Haram area.

The central region was accustomed to a high density of traffic due to the lack of an alternative route avoiding it. At the time of the existing ring roads mentioned previously, these roads linked up with them, diverting the traffic flow away from the Haram area. This was thought to be a well-balanced city network. The system provides services for the districts it serves and connects them with the ring roads, thereby creating easier access to the city centre and lessening traffic jams on the main streets. On the other hand, traffic jams still exist on some of the roads and this problem will be analysed under traffic congestion and bottle-necks in a subsequent Chapter. In this section, the study is devoted to the main city streets in order to establish their condition and function in serving the city traffic. Some of the main city roads have been improved because it is important to relieve the congestion on them as they often take a direct route to Al-Haram, passing through high density residential areas.

2.9.1 Projects to Improve Main City Streets

In 1400AH, 1980AD, a project was undertaken to improve the look and function of some streets leading to Al-Haram. Abrahim Al-Khalil street is one of the most important leading to Al-Haram. The road was widened to 25 metres which required the demolition of some houses, resulting in S.R. 157,962,629 (£813.7 million) being paid to house owners [41]. This street drew its importance from providing a direct contact with Al-Haram and serving Al-Missfalah district, which is becoming densely populated by pilgrims during the Hajj, keeping it busy most of the time. Thus, widening its narrowest part is of great benefit to both pedestrians and traffic. The road carries a high volume of traffic at all times. In addition to this, it carries a high proportion of pedestrians and pilgrims travelling to Al-Haram during Hajj and Ramadan. The proportion of pedestrian movement remains at an almost normal level for the rest of the year. The length of the street between Al-Haram and Al Yemen road is 6km, with two lanes in each direction [(42)]. It can be classified as a dual carriageway from the point where it starts at Al-Shusbikah district, going southwards and passing through a high density built-up area.

The other street which was also improved is Ajeyad Assaad street. This follows a westerly direction from the point where it joins with the tunnels coming from Mina. This road links Ajeyad Assaad with Al-Haram area, opposite the King's Gate of Al-Haram. It is approximately 1km long with three lanes in each direction and it crosses the Al-Haram ring road which the sacred capital's municipality is constructing [(43)]. The road is vitally important because it connects Mina directly with Al-Haram, through the tunnels. This makes for easier and quicker access for traffic converging on Al-Haram during the Hajj, which in turn reduces the congestion on the Haram road which passes through many districts on the way from Mina.

There is another branch of this street which takes a southerly direction, namely Ajeyad-R'ii Baksh street. This was widened to 25 metres and is approximately 3km long, with two lanes in each direction [44]. This road links Al-Haram with Jabal Al Thur street, south of Al Haram. It is vital as it provides a direct route between Al Haram street, the parking area and Road No. 1 leading to the holy sites. The same road also provides services for Ajeyad and Al-Missfalah districts and also for hospitals and hotels around it. It serves shops facing the King's Gate of Al-Haram. The road carries a high traffic volume to Al-Haram area at Hajj and Ramadan, creating a car parking problem. This will be analysed in one of the following Chapters.

2.9.2 Al-Haram Street

This road forms a semi-circle around Al-Haram, connecting all streets leading to it from west, north and south. It goes northwards from Al-Haram area at a point called Al-Qushashiah to a spot near Al Maabda district. This road can be classified as a collection and radial road as it attracts most of the traffic to Al-Haram and, at the same time, distributes it to different centres after the prayer time. This road provides services specifically for the Central Business District (C.B.D.) and gives access to the multi-storey car park next to Al-Haram. The street is busy constantly, with a peak period at the time of daily prayer and a critical peak at Friday Prayer. Pedestrians also intermingle with the cars crossing to Al-Haram, causing frequent traffic jams and congestion. Thus, the completion of the Al-Haram ring road will be of great benefit in alleviating this problem and in easing the traffic flow. The street is surrounded by a high density built-up area, with multi-storey buildings on both sides facing Al-Haram. The road is one-way, but has two or three lanes and is approximately 3.5km long [45]. It is suggested that there should be zebra crossings every 200 meters in order to control pedestrian movement. This would separate the people on foot form those driving and would provide a short term solution the the congestion until the Al-Haram ring road has been completed.

2.9.3 Ibn-Khaldoon Street

This road is located to the west of Al-Haram. It starts at a point called Al Shubikah and continues westwards, crossing the central ring road and then joining the Jeddah expressway. From the starting point until it meets the Jeddah expressway, the road is approximately 8km long and two or three lanes wide when approaching the expressway. It passes through busy and high-density built-up areas. The road provides services for the districts it runs through and the commercial area along both sides of it. The route links the Jeddah expressway with the Al-Haram area and gives access to traffic between Al-Haram and Jeddah. At weekends and to some extent during the week, it carries a high proportion of traffic to the Al-Haram area, where the number of visitors increases during Ramadan and the Hajj, putting pressure on the Al-Haram locality. The traffic volume on this road and other main streets will be discussed in Chapter 5, from data obtained from the Hajj Research Centre where a survey was carried out in 1983, to count cars on main streets during the Hajj, and three months after the Hajj. The duration of time this survey represents is three days during the Hajj and one day outside the Hajj. The analysis also makes use of the results of the personal fieldwork carried out in 1985.

2.9.4 Abdullah Ibn Az-zubayer Street

This road is located to the west of Al-Haram. It meets the Haram street at two points, one in the north at Al Maala, near Makkah's main post office, and the other at the Al-Shamiah district, west of Al-Haram. It runs through the Al-Falg hills, sloping slightly from the starting point. This road is one-way, (traffic flow is from north to south), three lanes wide and approximately 1km long. The road provides services to the Al-Haram area, the commercial area and to the hotels which extend along both sides. It also serves the residents of Al Shamiah and Al Falg district (as far as Al-Haram). This road is subjected to a high volume of traffic during Hajj and to a lesser extent at Ramadan and during the rest of the year. In addition to this, many pedestrians use the road on their way to Al-Haram, which causes problems similar to those of Al-Haram street. A zebra crossing is necessary to alleviate the problem.

2.9.5 Al-Taneem Road

This road is located north of Al-Haram, starting from Al-Ummrah mosque and connecting with Al-Medina expressway. From this point the road turns south and links with Jabal Al-Kaaba street and hence the Al-Haram area. From Al-Ummrah mosque to Jabal Al-Kaaba street the road is approximately 5km long with two lanes in each direction [(46)]. It provides services to Al-Haram area, where the traffic to and from Al-Medina uses this road. This makes the road very busy most of the time, particularly during Hajj and Ramadan. It serves the districts through which it passes and the government offices and hospitals along both sides. There is great pressure both from local traffic and that coming from Al-Medina.

2.9.6 Al-Aziziah Street

This street is east of Al-Haram and links Al-Maabdaa district with Al-Aziziah district. Al-Maabdaa street provides continuity for this road to Al-Haram street, and at one time was the only connection with Al-Haram, experiencing a high level of local traffic and traffic coming from Taif. This street is now connected with Al-Haram directly through tunnels by a road parallel to it and starts from the south at Al-Aziziah district. This serves the approaching traffic from Taif so that it does not cross local traffic, helping to reduce the heavy use of this road. The road has direct connection with Al-Haram and from a point called Dugm Al Waber on the central ring road is approximately 9km long, with three lanes in each direction. It serves Al-Awaly district, south of Al-Aziziah district, and the district through which it passes for schools, hospitals and government offices. It is also vitally important because it connects the university of Umm Al-Qura with the central ring road, which attracts much traffic in connection with the university. From 08.00 to 09.00 the street is busy with student cars converging on the university from different districts within the city. Other factors keeping this street busy are local traffic, visitors to hospitals coming from other areas, and buses serving the residents of Al-Aziziah district.

2.9.7 Al-Rusifah Street

This road is west of Al-Haram. Starting in the southern part of Al-Hindawiah district, it follows a northerly route, crossing Ibn Khaldoon street, and meets the old Jeddah road. It provides services for Al-Hindawiah and Al-Rusifah district and the commercial area along both sides. The street is approximately 4km long with two lanes in each direction. It is busy with cars in the commercial area between Ibn Khaldoon street and old Jeddah street, where two peak periods occur, one in the morning and the other in the afternoon. This road passes through a low-density built-up area, which is mentioned above.

2.9.8 Al-Mansoor Street

This street is considered an extension of Abrahim Al-Khalil street. It starts at the point where Jurham street meets Abrahim Al-Khalil street and takes a northerly direction, crossing Ibn Khaldoon street to meet old Jeddah road then crosses that to meet Qasar Al-Diafah street. It is approximately 5km long, with two lanes in each direction. This street serves the districts through which it passes and the shops which line its sides. It is a busy street since it carries a high proportion of shoppers' cars and many pedestrians.

2.9.9 Al-Hejoon Street

This street is north of Al-Haram and takes an east-west direction to meet Al-Haram street at a pioint called Al-Maala, starting from a spot linked with Al Taneem street. This road is approximately 2km long with two to three lanes in each direction [47]. The built-up area has influenced the shape of this road and its width. The street is busy most of the day where it passes through densely populated districts such as Al-Utibiah. This road serves the residents of Al-Utibiah travelling to Al-Haram area and it also serves the shops of the commercial area along its route. In addition to this, it provides services for vehicles coming from old Jeddah road and heading for districts in the north of the city. This, together with the local traffic, generates heavy use for this road, keeping it busy and congested.

2.10 Secondary Streets

This type of road network consists of narrow streets, relatively shorter than the main streets. Total network length is approximately 61km which is less than the length of arterial roads and main streets, the combined length of which is 169Km. This type of system provides services for the built-up areas and connects them with the main streets. The traffic in this system flows in two directions, without a central reservation which is characteristic of the main streets and arterial roads. As mentioned earlier, the purpose of the central reservation is to separate the traffic passing in each direction, reduce accidents and control traffic flow. It is not possible to construct a central reservation on secondary roads because the roads would have to be widened and houses demolished in the process. This is not considered necessary since secondary roads do not carry as much traffic as main and arterial roads. In this section three streets in this system in Makkah will be discussed in order to establish their function and traffic conditions on them.

2.10.1 Jurham Street

This street runs parallel between Abrahim Al-Khalil and Al Mansoor streets. This street is two-way, with one lane in each direction, and is approximately 3km long. It connects Abrahim Al-Khalil street with Ibn Khaldoon street. Jurham street provides services for the built-up area in Al-Tundubamay district. It serves the public bus station in this district, which is considered to be one of the main bus stations in Makkah. It also provides services for Suk Al-Khanam (livestock market). Additionally, it serves schools and the girls' university, which keeps the street busy during two periods, one in the morning and the other in the middle of the day (07.00 - 08.00 and 13.00 - 14.00). Many cars use this road, transporting boys and girls to and from their places of study (48).

2.10.2 Khalid Ibn Al-Walid Street

This street starts at the junction of Jabal Thur street, which runs to Al Haram. The road passes the multi-storey car park at Al-Missfalah and runs parallel with Abrahim Al-Khalil street, which it joins at a point called Suk Al-Barnoo. It is a two-way street, which is approximately 2.5km long and has one lane in each direction. The street serves a clinic, schools, grocery shops and the residents in Al-Missfalah. It is one-way from the grocery shops as far as Al-Haram. A zebra crossing is required on this road to allow pedestrians to cross safely (49).

2.10.3 Al Jazair Street

This street starts at the connection with Al-Hejoon street and crosses Al-Utibiah district to meet Al-Hajj street. It is one-way to allow the passage of one car with ease and is roughly 3km long. The street is busy, with an afternoon peak (16.00 - 21.00) when shoppers frequent the clothes shops which line it.

It provides services for residents and schools, also shops located to the north of this street [50].

2.11 Tertiary Streets

This system takes the form of arterial roads in the residential areas of each district within Makkah. This network, known in Makkah as alleys, provides access to secondary and main streets for residents of each district. Some of the alleys are wide enough to cater for local traffic, but others are narrow and winding, restricting movement of motor vehicles within districts and between one district and another. The narrow alleys make it difficult for ambulances, fire engines etc. to gain access. This problem should be given priority by the city planners and the alleys widened to allow the passage of traffic. An example of this are the alleys located at Shaib Ali and Shaib Amir.

2.12 Tunnels in Makkah

The characteristic topography of Makkah is very steep and built-up areas are surrounded by hills and mountains which, in turn, create problems in communications between the scattered areas of the city. The overland roads could be used to link these areas, but would create a design problem in constructing short roads, suitable to meet travelling demands within the city. The city planners have given priority to this problem and as a result have already started to build tunnels to achieve a network which will meet all the needs of the city and its residential areas. The city of Makkah benefits greatly from these tunnels and has gained the name of "the city of tunnels", since it has more than any other city in the Kingdom. The tunnels have a significant influence on the city network as they have shortened the distance be tween areas. The existing and proposed tunnels and their function will be discussed in this section.

Tunnels are classified according to function and are here discussed under two heads: pedestrian tunnels and vehicular tunnels (in accordance with the municipal classification).

2.12.1 Pedestrian Tunnels

One tunnel has been specifically created for pedestrians and forms an extension of the pilgrims' pedestrian road from Arafat and Mina. It extends from the Al-Haram area to a point between Al-Aziziah district and Mina. Pedestrians use the tunnel when walking to and from Al-Haram and the Holy Sites during Hajj [51].

2.12.2 Radial Tunnels for Vehicle Use

Most tunnels in Makkah have been constructed to carry the flow of people and vehicles radially towards the holy mosque. In 1981, the first two tunnels were built and these are in use at the present time. The first tunnel connects Al-Missfalah district (opposite the multi-storey car park) with Al-Haram district (facing the King's Gate). The length of the tunnel is 700 metres and the width 16 metres, one half being designated for pedestrians and the other half for cars. The second tunnel (also facing the King's Gate) links the pilgrims' parking space with Al-Haram street. The tunnel is 1800 metres long, 16 metres wide and divided as the previous one. These two tunnels are connected with two channels, serving as emergency exits. The purpose and function of the tunnels is to speed up the traffic from the points mentioned above to Al-Haram and to reduce the number of vehicles on Abrahim Al-Khalil street.

There are four similar tunnels under construction. Two of these will connect Al-Tundubamay street with Abrahim Al-Khalil street. This will attract traffic flow from this street to the west side of the city and will also reduce travelling time between the two areas. The other two tunnels will connect Al-Utibiah area with Bab Al-Umrah area just to the west of Al-Haram. These tunnels will be in use by the end of the third development plan in 1990 [52].

2.12.3 Recommendations

The tunnels which already exist in the city of Makkah require some maintenance to keep them functioning efficiently and to attract regular users. As observed, we would strongly recommend that the engineer find a solution to the lighting level inside the tunnels in order that it should correspond with that outside. Drivers' vision is affected by the light difference, making it difficult to adjust on leaving the tunnels. In some instances there is no lighting at all outside the tunnel, as in the case of Al-Suliminiah tunnel, making it hazardous when driving at night. In insufficient light, it is also difficult to follow road signs. Accidents have occurred due to inadequate lighting. For example, an accident happened at the exit of one of the tunnels between Al-Haram and Al-Aziziah. It was during the night and the driver was confused because of the poor lighting and hit the wall outside the tunnel [53]. Finding a solution to this problem will reduce accidents in the city. Another point is also strongly recommended and that is the building of a concrete canopy at the entrances and exits of the tunnels. This would prevent rocks from the mountains falling on to the approach roads to and from the tunnels. This recommendation should be given priority by the city engineer because falling rocks present a great danger, particularly in the rainy season when drivers and their cars are at risk. Also, falling rocks could obstruct and damage the roads linking the tunnels.

2.12.4 Tunnels on the Ring Road

A number of tunnels are needed for the ring road system in Makkah. These tunnels would reduce the problems of restriction facing the city network, caused by hills and mountains. Hills and mountains no longer stand in the way of developing the city network, due to new methods of technology, so that many roads now cross them (see Plate 3).

Plate 2.3 Tunnels in Makkah. (Photo.Z.A.Mekki,1986).

There are four tunnels on the Haram ring road, three of which have been completed and are open for traffic. Two tunnels are located to the east and north of the Haram and two are to the south. On the inner ring road five twin tunnels have been finished. Two were opened for traffic during Hajj 1404AH (1984AD). On the central ring road, three tunnels are proposed, and one tunnel is scheduled on the western section of the outer ring road. No construction has yet been started [54].

The completion of the tunnels will raise the capacity of the city network by providing potential services for the traffic flow within Makkah. The proposed tunnels will enable the ring roads to fulfil their function completely, in speeding up and organising the traffic flow at peak times and day to day.

2.13 The City Network Flyovers

There is no data about flyovers in Makkah, but personal fieldwork was carried out in 1985 in order to establish the function and importance of flyovers to the city network. Two flyovers covered by the survey mentioned above are discussed below. Several flyovers are significant to traffic flow within the city, and provide access to, and ease connections with, other roads. Flyovers are vital to the city network in that:

A they facilitate continuous traffic flow and ease traffic jams on roads coming from different directions;

B they facilitate interchange from one route to another, while maintaining the speed of traffic on the city network;

C they play an important part in reducing the number of traffic lights required at the junctions on flat routes, thereby enabling cars to keep moving at a good speed.

D they contribute to the reduction of accidents at junctions.

2.13.1 The Important Flyovers

Two important flyovers, covered by the 1985 survey, ease traffic congestion in streets over which they pass. These flyovers are:

1 Ibn Khaldoon street flyover; and

2 Qassar Al-Diyaffa flyover.

Ibn Khaldoon street flyover is located on the main street, coming from west to east, and goes directly to Al-Haram. This flyover carries the traffic from Jeddah expressway to Al-Haram where it ensures continuity of traffic flow without interfering with the traffic on Al-Mansoor street, which passes from south to north. Since the opening of the flyover traffic congestion has been eased, delay reduced and the pressure of vehicles lessened on the streets mentioned above, where previously traffic lights had been in use.

Qassar Al-Diyaffa flyover is located on the main street from the old Jeddah road. This flyover carries traffic from old Jeddah road and goes in the direction of Al-Utibiah district and northern parts of the city. This flyover also ensures continuity for traffic travelling from west to east, without affecting the traffic flow on Al-Taneem street, which runs north to south. The flyover separates the traffic from Al-Medina expressway and going through Al-Taneem street. The speed of traffic is maintained and, since the flyover has been in use, there have been fewer accidents at the junctions.

2.13.2 Recommendations

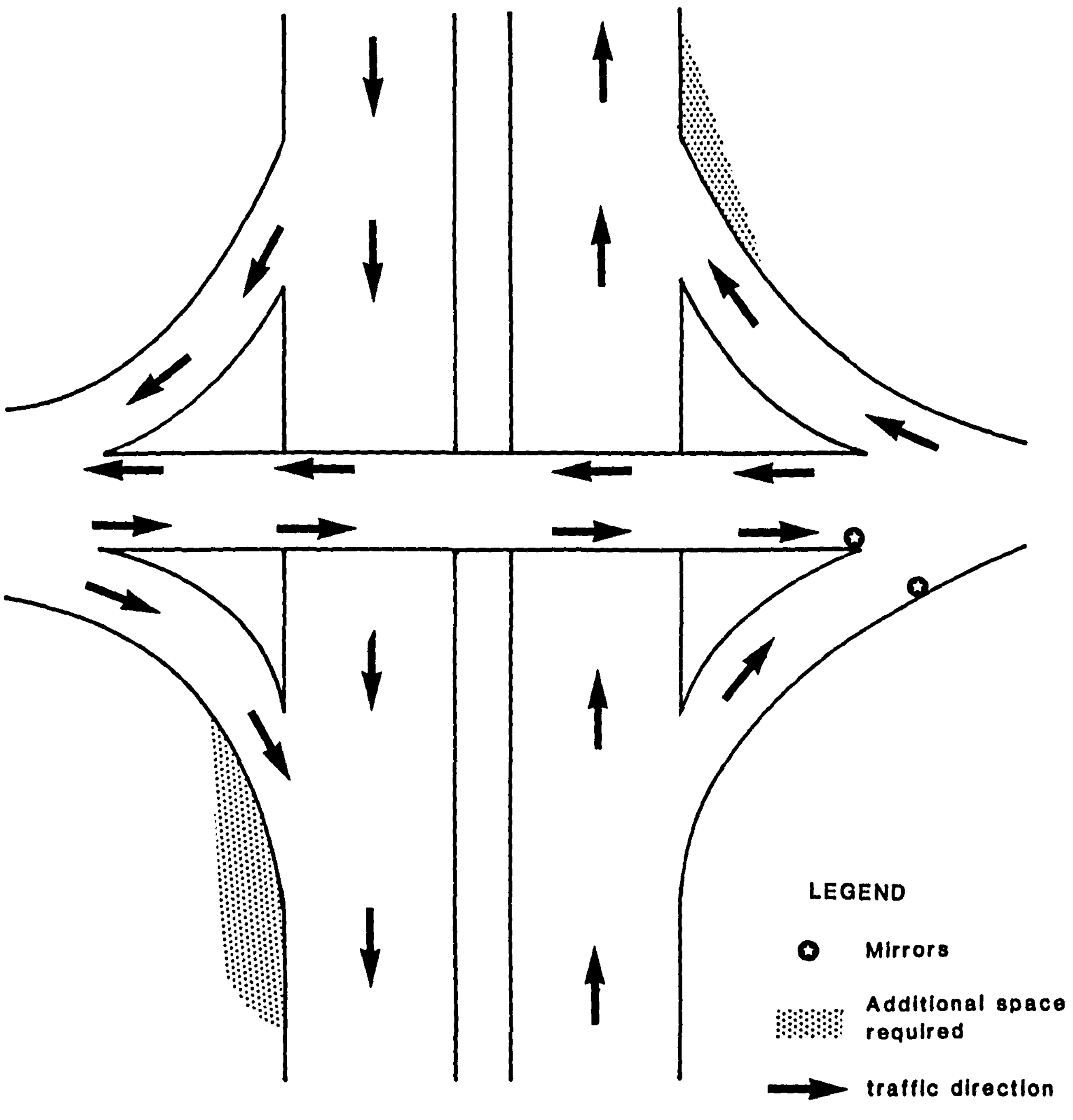
Observation in the survey showed that traffic using the flyovers, particularly at junctions with the overland routes, would benefit from two improvements: more space should be provided where the flow from the flyovers joins the flow on the overland route, in order to allow the traffic to merge smoothly; also, there should be a mirror on roads joining the flyovers. The mirror should be placed at junctions to enable drivers to assess the volume of traffic before joining it (see Fig. 2.9). This would help to reduce accidents and prevent a reduction in traffic speed.

2.14 Floods in Makkah

As mentioned in the previous Chapter, rainfall in Makkah fluctuates greatly, sometimes occurring at infrequent intervals and at others being characterised by heavy, torrential rain.

Among visitors to Makkah was Burckhardt, who came to the city in the eighteenth century. In his description of Makkah's climate, Burckhardt wrote:

Fig.2.9
SKETCH OF BRIDGE WITH EXITS AND APPROACHES



> The rainy season usually begins in December, but the rains are not uninterrupted, as in other tropical countries, falling at intervals of five or six days but then with great violence (55).

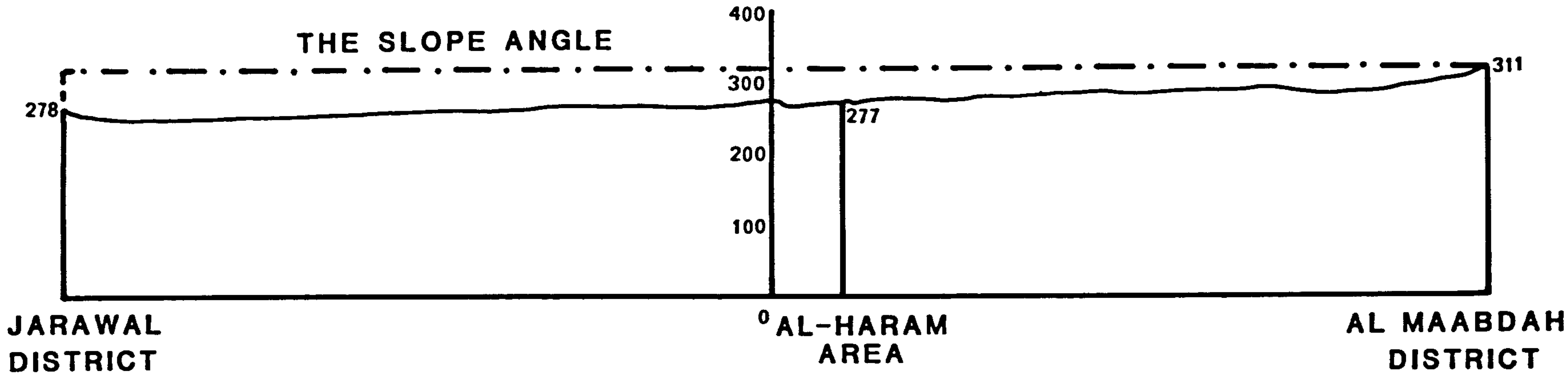
As mentioned above, the city of Makkah lies amid a complex of mountains and alluvial valleys which take a gradient from north to south and cause flooding to be drastic. The mosque is situated in a low part of the city at an elevation of 227 metres above sea level, while Al-Maabdah, north of Al-Haram, is 311 metres above sea level and Jarwal district, south of Al-Haram, is 278 metres above sea level (see Fig. 2.10) (56).

The gradient of the valley from north to south (as seen from the figure) and the topographical conditions cause many difficulties during the rainy seasons. At this time, most areas of the city suffer from flooding, especially around Al-Haram where the water overflows, due to its location in the low part of the valley (see Plate 4).

2.14.1 The Effect of Floods on the City of Makkah

During the rainy season in Makkah, the impact of topographical conditions, mountains and hills, together with the gradient of the valley, causes water to gather very fast and run rapidly down the valley of Abraham towards the lower parts of the city. This turns Makkah into a temporary lake, with houses surrounded by water and city roads overflowing. Sometimes such severe flooding is experienced that houses are swept away and roads are badly damaged.

Fig.2.10
ELEVATION OF SELECTED LOCATION IN MAKKAH ABOVE SEA LEVEL (HEIGHT IN METRES)



SOURCE: BASED ON NUMBERS PROVIDED (SEE TEXT, CHAPTER TWO)

Plate 2.4 Floodwater around AL-Kaaba in 1968.
Source: Sabry photo Lab, Makkah.

One of Makkah's historians mentioned the violence of floods in the city when he wrote:

> In 1325AH (1908AD) and during the Hajj time it was raining very heavily, which caused a huge flood similar to the flow of the Nile River in Egypt. The flood swept away more than one hundred houses and filled city streets with rocks and gravel. The depth of water in the city streets was 2 metres. This caused the city traffic to be interrupted and people could not even cross from one side of the street to the other on animals, which it was very risky to do. Some people were seen swimming from one side of the street to the other side (57).

It can be seen from the foregoing that flooding has a great influence on the city, especially upon roads which are considered the most vital part, as an arterial link between the city centres. When affected by floods, these roads become completely paralysed. It can be deduced that road conditions in the past, when they were often sandy, were greatly affected by running water during times of flood, causing damage to the roads and restricting traffic. These restrictions have been discussed above with reference to the fact that city roads were unpaved and old methods of transportation were used. With the introduction of cars and the development of street patterns, city roads became asphalted and suitable for modern traffic, although still being affected by floods. Referring to rainfall, this runs from hills and mountains towards the city sedimentary plain, where part of it seeps through the soil and the rest continues to flow over the land surface, causing flood damage to the inhabited areas within the city. The expansion of the city's built-up area has reduced the amount of soil available for water absorption. The replacement of sandy road surfaces with asphalt has further decreased the seepage area and therefore the problem of running water has increased. This creates great problems for modern transport and the city traffic.

2.14.2 The Effect of Flooding on Recent Roads and Automobiles

As the city of Makkah lies in the valley of Abrahim, amid complex topographical features, the earliest roads to be created followed the natural course of the valley. This aggravated flooding on the city's main roads, which were asphalted and lay on the plain, which was affected by flood water. The stones and mud which are washed down from the hills, mountains and upper valley, abraded the asphalt road surface, thereby causing damage (see Plate 2.5). Potholes are commonly seen on city roads during the rainy season, which in turn form pockets for water collection (this situation could reduce the city network's level of services and affect the city traffic). Flood debris can cause severe damage to vehicles and also result in congestion and accidents, since drivers swerve to avoid obstacles in their way. Potholes and flood material temporarily restrict the amount of road available for use, causing congestion and delay. Unfortunately no data is at hand concerning the cost of removing flood debris and repairing roads after the rainy season.

Another difficulty caused by flooding is the skidding of cars because asphalt surfaces become wet very quickly which reduces the level of wheel friction (58). This could lead to

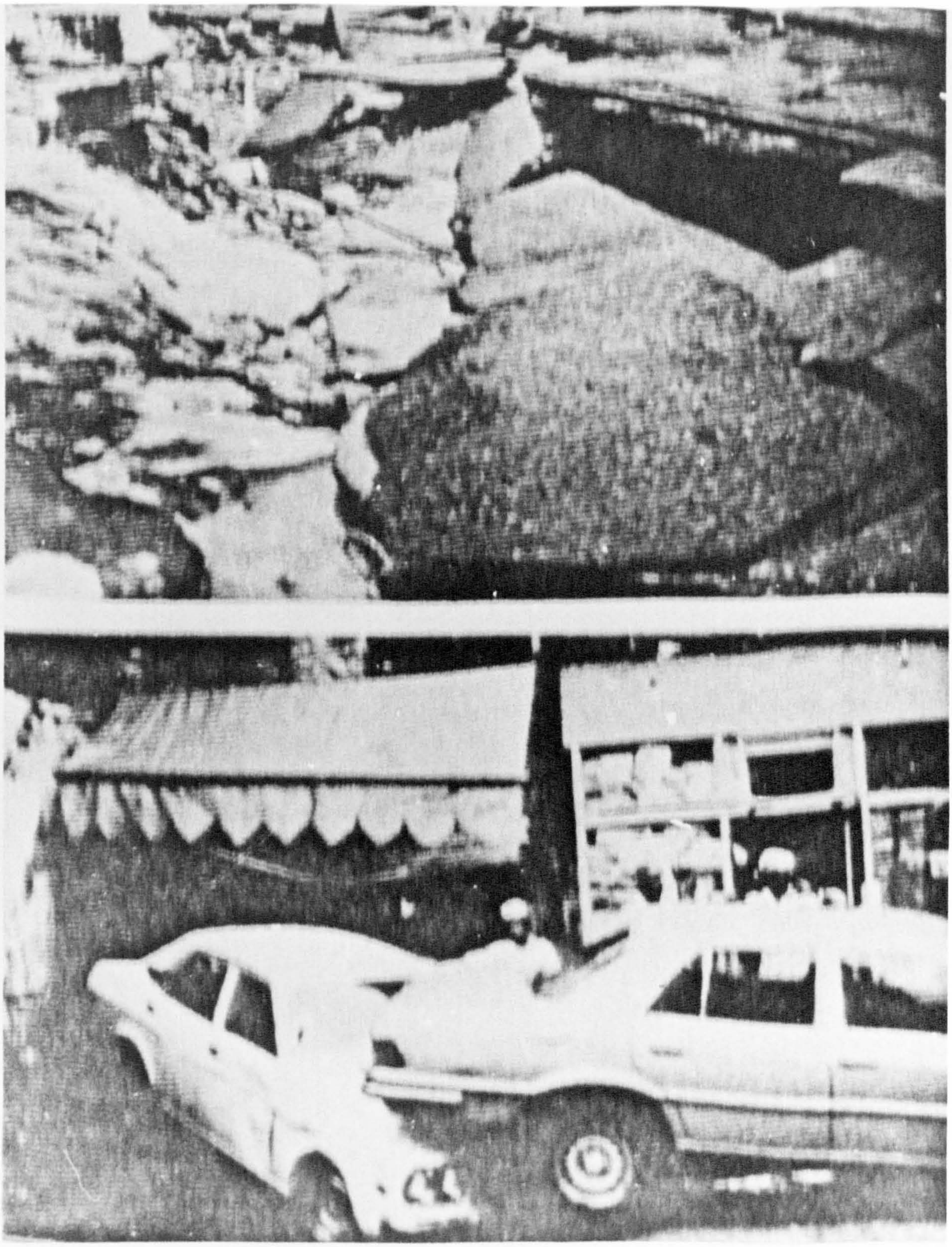


Plate 2.5 Damage to city streets caused by severe flooding (1980).
Source: Majdi, M.Hariri (1986).

accidents through cars skidding out of control, either into the side of the road or into oncoming traffic. When flooding is more drastic, vehicles can be swept away, resulting in death, as occurred in 1391AH (1971AD) [59].

2.14.3 Controlling Floods

Since flooding has caused such problems for Makkah, the inhabitants and governments have, at different times, tried to control flooding in order to protect the city. A map concerning the drainage of flood water has been obtained from the Ministry of Municipal and Rural Affairs and more data is available from history books of Makkah, relating to flood control. This information has been referred to in considering the previous and present strategy. Different methods have been adopted to control flooding, including the creation of sewers, dams and tunnels. It is important to note that the concept of dams varies from period to period, according to the strategy followed by those in charge of flood control.

In the Kuza'a period (before the Islamic period, pre-556AD), flood damaged the entire city of Makkah and surrounded the holy Kaaba. As a result, the Kuza'a tribe built a wall around Al-Kaaba which was the first time the city had been protected from flood. The wall built at this time was in the form of a dam, to protect the Haram and Al-Kaaba [60].

In 17AH (597AD), at the time of Khalif Ummar, the flood was devastating, destroying houses and crossing the wall where it damaged some parts of Al-Haram. A soil dam was built north of Al-Haram at Al-Mudaa and this consisted of large stones with earth between them. This dam forced the flood to divert from the Haram area towards the valley of Abrahim. Thus, the Haram and houses near to it were protected (61).

It can be seen from the foregoing that most of the strategy followed to control flooding was limited to the Haram area and nearby houses. This was not sufficient to protect the whole city from flood. As a result, the need to safeguard Makkah from deluge became a matter of great concern for the city authorities.

In 916AH (1486AD), a stone dam was built at Herra mountain, north of Al-Haram, on the way to Mina. This dam prevented the flood from reaching the upper part of the city of Makkah, but when the volume of flood water became too great, the dam leaked, although there was no severe damage to the city. In addition to the city being saved from flooding, the water was diverted in a westerly direction towards Jeddah and the Red Sea. Since the creation of this dam was successful, another was constructed in the Ajeyad district. The purpose of this barrage was to eliminate flood water coming from Ajeyad area towards Al-Haram, thereby reducing the risk of flooding in the latter. This dam still exists to the present day (62).

It can be said that the city drew great benefit from these dams in preventing flooding in the urban area. However, flooding still occurs in Makkah as a direct result of rainfall overflowing the city streets. It is necessary to drain the water in the urban area in order to reduce the damage to city roads. As a result, new technology has been adopted by the Saudi government to control the flooding within the city.

In 1375AH (1955AD), a project was launched to excavate a tunnel under the Haram area. This tunnel runs towards the east, starting behind the mountain of Al-Safa, which faces the Ubo-Qubyes mountain. It provides access for the flood to pass under Al-Haram and continue southwards to the outskirts of the city [63].

While the tunnel mentioned above prevents flooding in Al-haram, it is of no great benefit to the rest of the city because it is not comprehensive enough and most city streets still suffer from flash flooding. This is the case in Al-Haram street and Abraham Al-Khalil street. The latter passes Al-Missfalah district and the tunnel (already referred to) passes under its road surface. The tunnel was not provided with collection chambers in this area, so the street becomes flooded, sometimes paralysing the traffic flow.

The city authorities acknowledged this problem and planned to adopt a comprehensive method to control flooding on city streets to enable traffic flow to continue. As a result, in 1976, a project was started to build a complete rain water drainage network to serve the entire city [64]. In 1984 the scheme was completed and the principal water drainage network now extends through the main valley water course. The cost of this project was S.R. 241 million (£4,677,611). The network consists of cement boxes, sewers and ready-made concrete tunnels, the purpose of which is to collect rain water and drain it towards the outskirts of the city (see Fig. 2.11). The network provides collection chambers on the main streets which allow the rain water to seep through existing tunnels, thereby reducing the incidence of flooding drastically within the city of Makkah. The collection chambers occur every 80 to 100 metres.

The project also included a diversion wall which re-routed the flood water coming to Makkah from the north. This wall kept the water flowing to the north with a slight westerly inclination. Two dams, positioned at Al-Shuhadah district, kept the flood taking a north course to Fatmah valley [65].

In spite of building the rain water drainage network, the city still suffers from flooding. I observed this personally during fieldwork in 1985, when the rain water gathered rapidly, overflowing the city streets, causing difficulties for city traffic. Unfortunately no photographs were taken at the time (due to lack of a camera), but the daily newspaper published photographs and these are used to substantiate the observation. In the same year, water was seen to be lying in some areas where it remained for four days, eventually being evaporated by the heat of the sun. This occurred in Al-Rusifah district street (see Plate 2.6) and Al-Abtah street, near Al-Maabda district. Figure 2.12 also shows the areas affected by flooding and

Plate 2.6 Roads under floodwater in western Makkah in November 1985;poor drainge design is responsble for such floods,several times each year.
Source:Al-Nadwa Daily, Makkah,(21 November 1985).

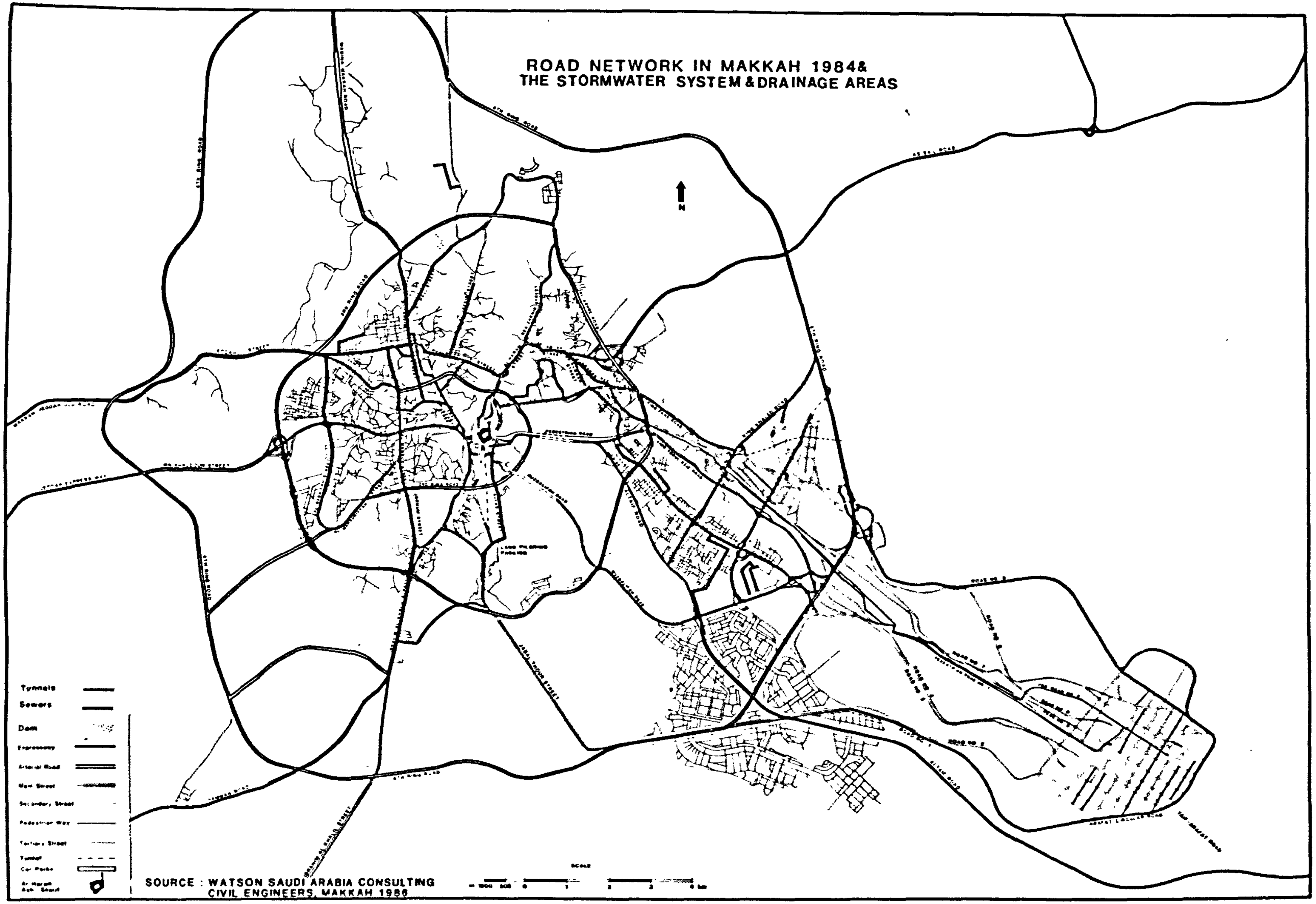

ROAD NETWORK IN MAKKAH 1984&
THE STORMWATER SYSTEM & DRAINAGE AREAS
N
Tunnels
Sewers
Dam
SOURCE : WATSON SAUDI ARABIA CONSULTING
CIVIL ENGINEERS, MAKKAH 1986

Fig.2.11

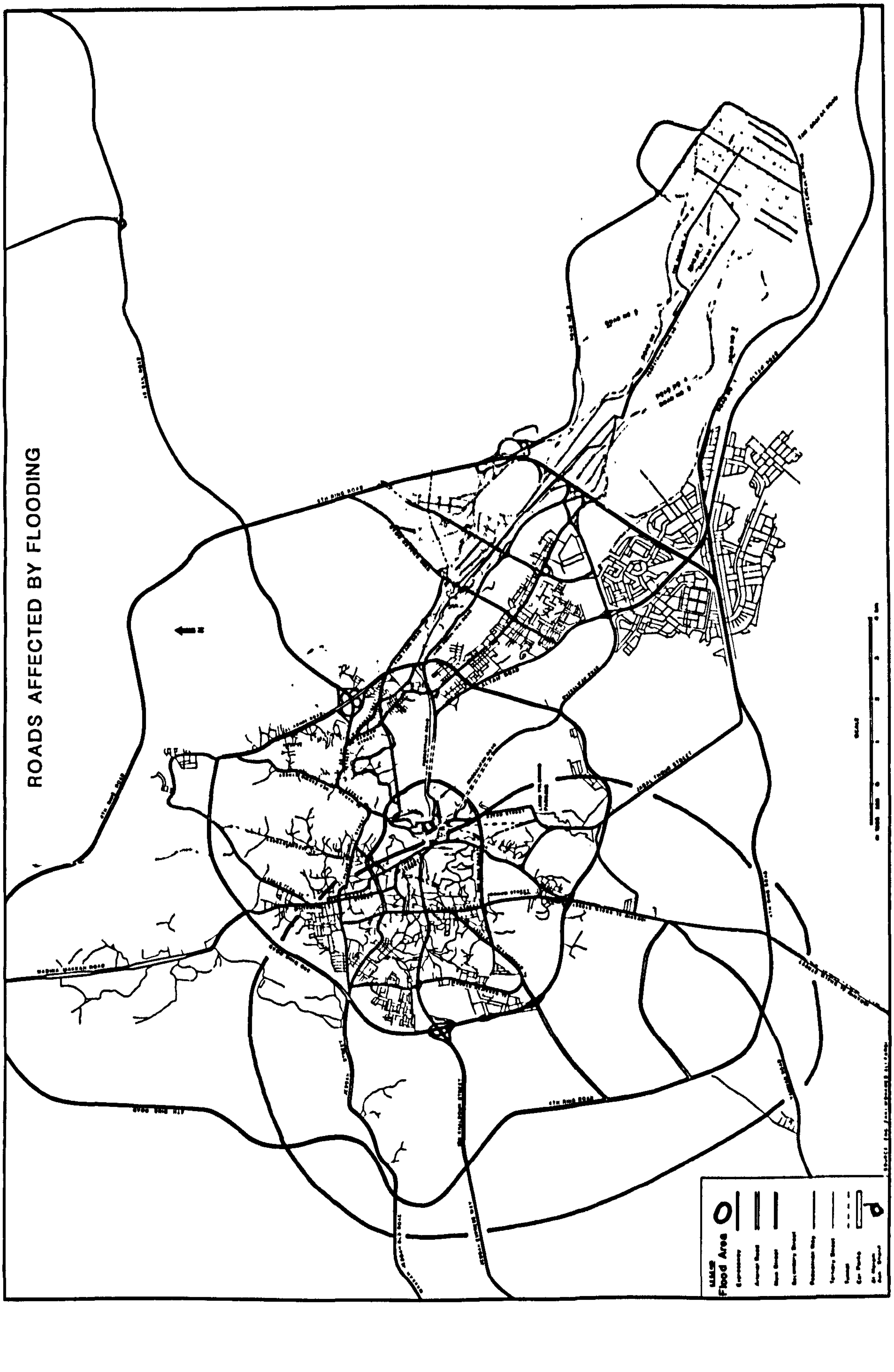


Fig.2.12

stagnating water lying on the city streets. This stagnant water remaining after the rainy season creates problems for city traffic as driving becomes hazardous. Thus, these streets are avoided, causing severe congestion on alternative routes which are unaffected by the water.

2.14.4 Recommendations

It is obvious from the foregoing that the rain water drainage network absorbs water only on the city's main streets. There should undoubtedly be a sewer extension to minor city streets and alleys in every district, with collection chambers to allow seepage into the main drainage network. This would help to end the problem of stagnant water, reduce the damage to road surfaces during the rainy season, and also alleviate congestion on the roads. In addition, as mentioned previously, topographical features play a significant role in allowing the rain water to gather and run very fast towards main city streets. Collection chambers are required in the foothills, in addition to those already recommended. This measure could lead to the reduction of the drastic amount of running water during the rainy season and lessen traffic congestion at that time of year.

2.15 Conclusion

It is apparent from the discussion of this chapter that the city road transport network witnessed two stages of development. The first stage dates from the city's beginnings, during which the dominant means of transportation was walking on foot and using animals for transporting goods and people (as existed in any city before the invention of the motor vehicle). The second period of development was when the city witnessed the introduction of the motor vehicle, which put pressure on to improve and expand these old narrow twisted streets which are the product of an earlier age. It is clear that the development of the city road transport network was rapid as Makkah expanded under the influence of large oil revenues in the Kingdom of Saudi Arabia.

The city's present network has to provide for day to day population movement as well as seasonal flows of pilgrims and visitors. The development of the city road network was the natural response to an increasing demand for mobility, while the city also grew with the rise in population and increasing numbers of pilgrims. Road networks also had to come to terms with the annual increase of motor vehicles heavy use which is fully discussed in Chapter 3).

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34 Survey and interview with truck drivers and policement at the check point on the road mentioned. Fieldwork 1985

35 Master Plan Report, Makkah, 1971, Ministry of Interior, Municipal Affairs, Regional and Town Planning Department, Kingdom of Saudi Arabia p.99

36 Al-Medina Daily (special issue about Makkah) July 1984 p.28

37 Al-Nadwa, Daily Makkah No.8053 September 1985 p.4

38 Al-Nadwa, Daily Makkah No.8069 September 1985 p.6

39 Al-Nadwa, Daily Makkah No.8069 September 1985 p.6

40 Al-Nadwa, Daily Makkah No.7755 September 1984 p.6

41 Data provided by Makkah Municipality. Fieldwork 1985

42 Measured on the 1:30,000 map of Makkah 1984

43 Land and Marine Transportation 1982 p.100

44 Al-Medina Daily (special issue about Makkah), Jeddah, July 1984 p.28

45 Distances measured on the 1:30,000 map of Makkah 1984

46 As 45

47 " "

48 " "

49 " "

50 " "

51 Survey. Fieldwork 1984

52 Al-Nadwa, Daily Makkah No.7755 September 1984 p.6

53 The accident mentioned above registered and the driver interviewed. Fieldwork 1985

54 Data obtained from Dan Al-Handsah consultant (Shair and Partners), Jeddah, Saudi Arabia

55 Burckhardt J.L. reprint of the 1829 edition 1968, Frank Cass and Company Limited, London, England p.240

56 Elevation measured by engineer of the Administration Office of the Mosque Development Project (Mashru' al-Haram) 1955

57 Basha Abrahim Ri'ifat 1925, Vol.1 p.200

58 Data obtained from Traffic Police Office, Makkah, Saudi Arabia

59 The date mentioned and some of the data obtained from the note of Mr. Yakub Atar, one of the city residents. Fieldwork 1985

60 Al-Azraki Abi Al-Walid Mohammed Abdullah 250AH Tarik Makkah (History of Makkah). Reprinted in 1983, Dar Al-Thaqufa Press, Makkah, Saudi Arabia, 4th ed. Vol.2 p.166

61 Al-Azraki Abi Al-Walid Mohammed Abdullah 250AH, Vol.2 p.167. Op. cit.

62 Al-Kurdy M. Tahir, Vol.2 p.206

63 Data obtained from Makkah Municipality. Fieldwork 1985

64 The date was obtained from the office of Watson Civil Engineer Consultant, Makkah, Saudi Arabia. Fieldwork 1985

65 Interview with S. Farreed, civil engineer in Watson Civil Engineer Consultant's office, Makkah, Saudi Arabia. Fieldwork 1985

CHAPTER 3

POPULATION MOBILITY AND CAR OWNERSHIP IN MAKKAH

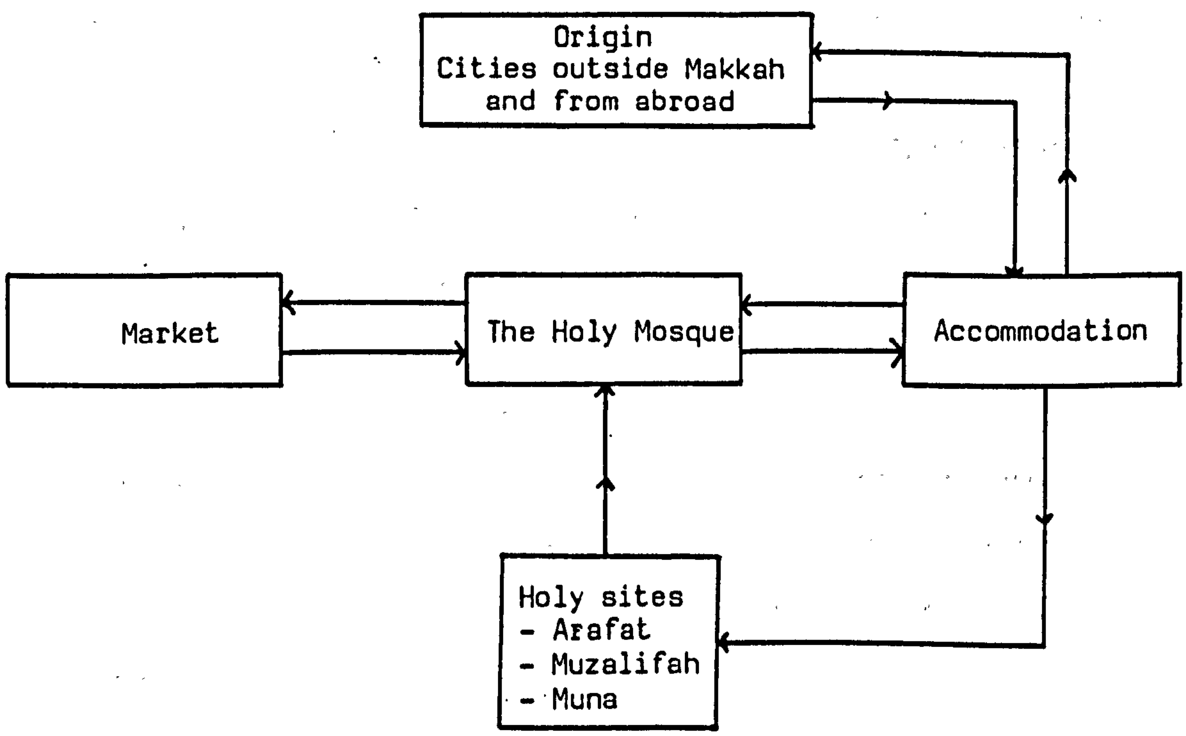
3.1 Introduction

The population of cities is constantly changing (1), for economic reasons and because movement is part of man's biological instinct (2). P.W. Daniels has classified the motives for man's urban mobility into: economic; social; educational; recreational; leisure and cultural (3). One of the chief functions of cities is to provide services to the surrounding region such as commerce, finance, education and health care. This inevitably leads to movement from the hinterland of the city for services, thus generating intense daily activity within the urban area (4). From this point of view, the patterns and motivation for movement in the city of Makkah are fairly typical. Makkah provides services for the villages located around it, while the villagers have the opportunity to sell their products there. Service provision creates jobs which in turn stimulate the movement of people within the city for work and commercial purposes, while the traditional spatial separation between home and work place creates daily activity of the employed population within city centres.

The function of Makkah, however, is not only economic, but arguably its main function is religious. It is the persistent strength of the religious role which fundamentally influences the other functions such as commercial activities, educational, health and other services which people require. Commercial activity associated with religious functions plays a significant role in catering for the residents and the stream of visitors to the city both during and outside the period of Hajj. The characteristics of activity in Makkah can thus be broadly classified into two categories: religious and economic. Makkah is recognised as the holy city of Islam, and therefore it is the destination of numerous Muslims during the annual pilgrimage. These numbered over two million in 1987. To a lesser extent, pilgrims also visit Makkah during the rest of the year. The annual influx of pilgrims from outside the city interacts with internal movements within the city.

The Masjid Al-Haram (Holy Mosque) is the central focus for most of the religious activity within Makkah. This plays a significant role in generating external trips from other city centres every day and from rural sources to the city. It also generates considerable internal movement (Fig. 3.1). The internal mobility of the city population is far more complex due to numerous factors which will be discussed later in this Chapter. Several phenomena play a significant role in causing people to move within the city, one of which is city growth, which has increased distances from the outer suburbs to the centre of the city. Another factor is the enlargement of the Haram itself, which required the removal of houses and other adjacent structures, resulting in the establishment of new dwellings away from the city centre, which generated trips from the new districts to Al-Haram. The third important circumstance causing increased travel is the growth of population from 100,000 in 1950 [5] to 366,801 in 1974 [6] and 599,400 in 1983 [7]. Makkah now holds third demographic place among Saudi cities, after Riyadh and Jeddah. Above all, perhaps, the increasing availablity of automobiles greatly enhanced population mobility in Makkah and provides the focus of this Chapter. Some reference is made to the growth in the number of vehicles in Saudi Arabia, to put the matter into context.

Fig. 3.1 The movement of Pilgrims and visitors within Makkah



Source:Author

3.2 Car Ownership in Saudi Arabia

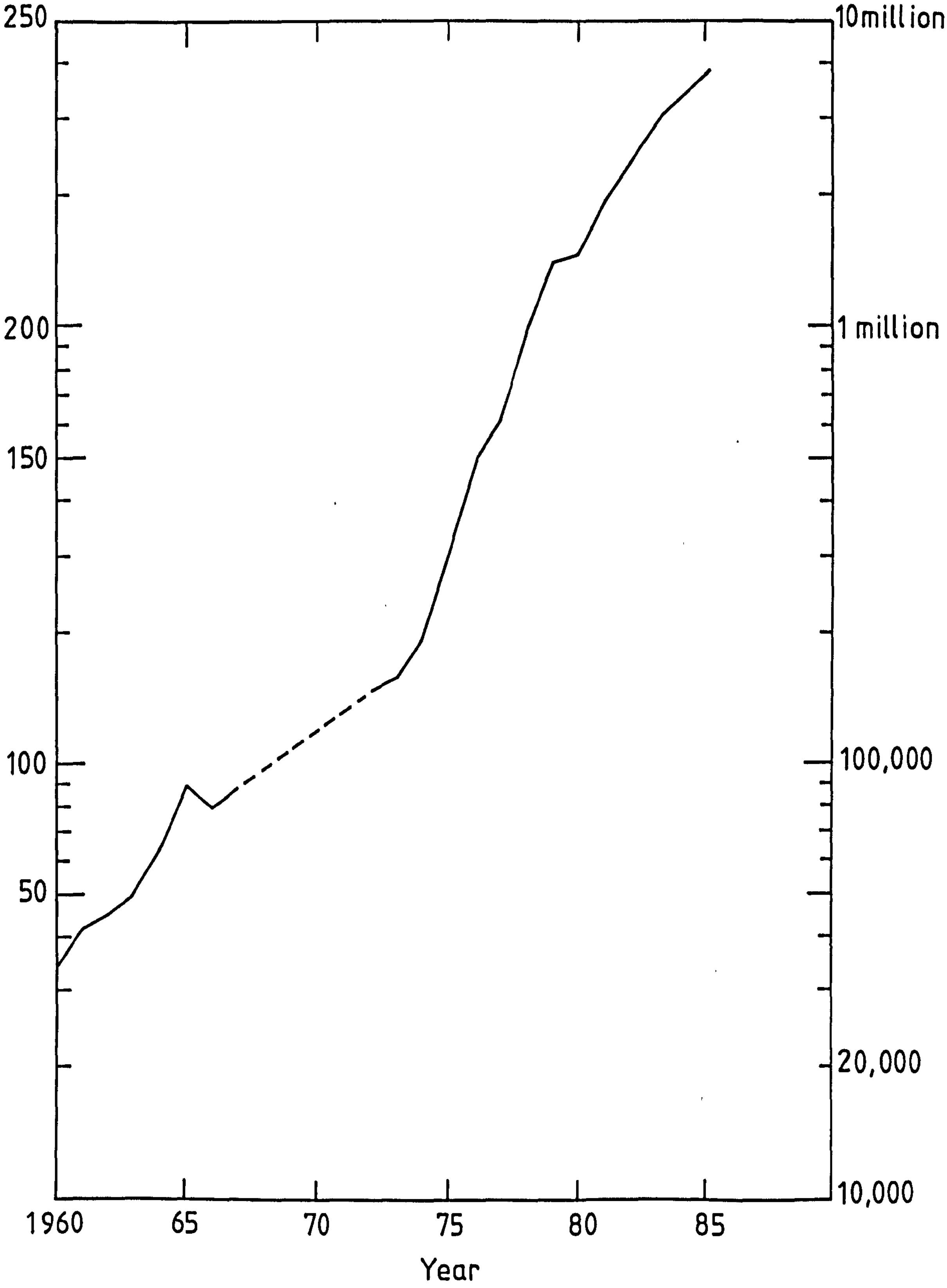
The number of vehicles in Saudi Arabia before 1960AD is unknown. However, there are figures for the period 1960-1985 (Table 3.1), which give an overall indication of the trend in vehicle growth over 25 years. A comparison between the number of vehicles in 1960 and 1985 (Fig. 3.2) shows more than a hundred-fold increase from 36,382 to 3,919,871. Figures given in the Table derived from official sources are however suspect for certain periods, especially the period 1968-1971AD. Levels of car ownership clearly correspond with the general economic growth witnessed by Saudi Arabia since 1950 [8]. This can be shown by the extension in the length of modern roads, from 111kms in 1950 to 20,238kms in 1980 [9], reflecting the increase of oil revenues from SR 34,000,000 in 1950 to SR 189,295,000 in 1981 and in government expenditure, which rose from SR 49,000,000 in 1950 to SR 165,724,000 in 1981 [10]. This economic growth has resulted in increases in the per capita income, purchasing power and consumption of foods and goods, as well as the construction of many projects [11]. Hence, many motor vehicles have been required to meet the need of this social and economic revolution. The country has no internal waterways and limited railways which has resulted in increasing the construction of roads, in order to cater for the increasing number of motor vehicles (Fig. 1.1, Chapter 1). The reduction of customs duty from 15% to 3% on automobile prices [12] has meant a big extra inducement for the Saudi Arabian population to buy cars. Thus, national car

Table 3.1 Number of motor Vehicles in Saudi Arabia 1960-1985

Year A.H.	Year A.D.	No.of Vehicles	Increase %*
1379	1960	36382	-
1380	1961	43185	18.70
1381	1962	47847	10.80
1382	1963	57738	20.67
1383	1964	71831	24.40
1384	1965	88874	23.72
1385	1966	80751	-9.13
1386	1967	90552	12.13
1387	1968	12621	-86.00
1388	1969	17260	36.70
1389	1970	19323	11.90
1390	1971	23308	20.60
1391	1972	144768	521.00
1392	1973	180185	24.40
1393	1974	242974	34.80
1394	1975	355022	46.10
1395	1976	514361	44.80
1396	1977	774443	50.56
1397	1978	1112973	43.70
1398	1979	1432909	28.70
1399	1980	1723116	20.20
1400	1981	2069479	20.10
1401	1982	2467903	19.25
1402	1983	3018811	22.30
1403	1984	3569009	18.20
1404	1985	3919871	9.80

*The percentage calculated by the Author.

Source:Statistical Yearbooks see[13]



250
200
150
100
50
10million
1 million
100,000
20,000
10,000
1960
65
70
75
80
85
Year
Annual increase in car ownership (,000) in Saudi Arabia

Fig. 3·2

ownership increased from 14.5 cars per thousand people in 1962 to 409 cars per thousand people in 1985 (Table 3.2). There is a considerable variation in price between type of cars imported into Saudi Arabia, with American and European cars costing more than Japanese (Table 3.3). The lower price of Japanese cars, which have been increasingly imported into Saudi Arabia, has contributed towards extending car ownership among the Saudi population. The low cost of locally produced petrol in Saudi Arabia also encourages people to use cars. In 1987 the cost of one gallon of Saudi petrol was SR 2.16 (£0.30 at the rate of £1.00 = SR 6.95). This low fuel price encourages car usage for all types of journeys, including those undertaken for leisure.

Table 3.2 Car ownership in Saudi Arabia (per '000 persons)

Year	Number of population	Number of cars owned*
1962	3,297,657 (a)	14.5
1974	6,726,466 (b)	36.2
1985	9,584,664 (c)	409.0

* Figures calculated by writer

Sources:

(a) Al-Sharif A.S. 1982, The Geography of Saudi Arabia, p.107

(b) The population census for 1974, Saudi Arabia

(c) Al-Ruiithii, M.A. 1979, p.35

Table 3.3 The price of cars by type

Type of car	Price in Saudi Riyals
American	78,000
European	40,000
Japanese	35,000

The prices given are for cars which carry 4-5 passengers

Source: Balbuide Motor Vehicle Agency, Jeddah, 1987.

3.2.1 Car Ownership in Makkah

The number of vehicles in Makkah before 1960 is unknown. However, figures since 1960 (Table 3.4) give an indication of the sharp rise in vehicle growth over a period of 23 years. This is a result of much the same factors which influenced the growth in the number of vehicles in Saudi Arabia. In addition, the religious significance of the city and the role which it plays in attracting both pilgrims and visitors during and outside the period of Hajj, stimulates a heavy local demand for transport services. The city population has a spending power resulting in wide car ownership. Table 3.4 also shows that these increases have fluctuated. The extreme changes between 1960 and 1971 may reflect economic factors, such as the closure of the Suez Canal, an economic crisis, the import restrictions made by the Saudi government on certain types of car (such as Ford) and the boycott of some European countries trading with Israel (14). After 1971, Table 3.4 shows a steady growth in the number of vehicles. A

Table 3.4 Number of Vehicles in Makkah and Al-Madina

Year A.H.	Year A.D	Makkah	Increase %*	Al-Madina	Increase %*
1379	1960	8967	-	720	-
1380	1961	9429	5.15	797	10.60
1381	1962	7901	-16.20	927	16.30
1382	1963	9384	18.70	1077	16.18
1383	1964	11139	18.70	1399	29.80
1384	1965	12172	9.30	1663	18.80
1385	1966	13675	12.30	2215	33.19
1386	1967	14217	3.90	?	?
1387	1968	855	-93.90	?	?
1388	1969	1342	56.90	588	-73.40
1389	1970	1288	-4.00	534	-9.18
1390	1971	1790	30.90	734	37.40
1391	1972	11900	564.00	7238	886.00
1392	1973	13588	14.00	8777	21.00
1393	1974	16501	21.40	11266	28.30
1394	1975	24047	45.70	17862	58.50
1395	1976	31660	31.60	26406	47.80
1396	1977	47113	48.80	36815	39.40
1397	1978	58754	24.70	44965	22.10
1398	1979	68957	17.30	49307	9.60
1399	1980	74797	8.40	55888	13.30
1400	1981	81197	8.50	63713	14.00
1401	1982	100516	23.70	79480	24.70
1402	1983	116509	19.60	103197	29.80

*Figures shown in the table calculated by the author.

?Data not available.

Source:See Table 3.1

comparison between 1960 and 1983 shows an increase in vehicles from 8,967 to 116,509. Figures given for certain periods are, however, suspect, as mentioned above, especially those between 1968-1971. Overall, the car ownership in Makkah increased from 56.4 cars per thousand people in 1962 to 208 cars in 1983 (Table 3.5). Comparing car ownership per thousand in Makkah and Al-Medina (Table 3.5) it was found to be higher in Makkah (Fig. 3.3). In both cities car ownership levels are above the national average.

3.3 Car Ownership in Makkah in 1985

From the foregoing it is obvious that the nature of car ownership in Makkah needs elaboration. In 1984 an intensive investigation was made by the author at the Traffic Office in Makkah and at the Traffic Police Headquarters in Ryadh. The investigation revealed that the only data available were the crude figures of car numbers in the city. Figures from the traffic police do not include specific details about car ownership in the city or its spatial distribution. As a result, a socio-economic survey was designed in 1985, to fill the gap in data. The investigation had also revealed that no data existed regarding population mobility, so this was included in the survey. This was to establish present private transportation characteristics and the contribution of private cars to population mobility.

Table 3.5 Car Ownership in Makkah and Al-Madina

Year	Population Number		Cars Owned per '000 *	
	Makkah	Al-Madina	Makkah	Al-Madina
1962	158908(1)	71998(1)	49.7	12.8
1974	366801(2)	198186(2)	45.0	56.8
1983	599400(3)	?	208.0	?

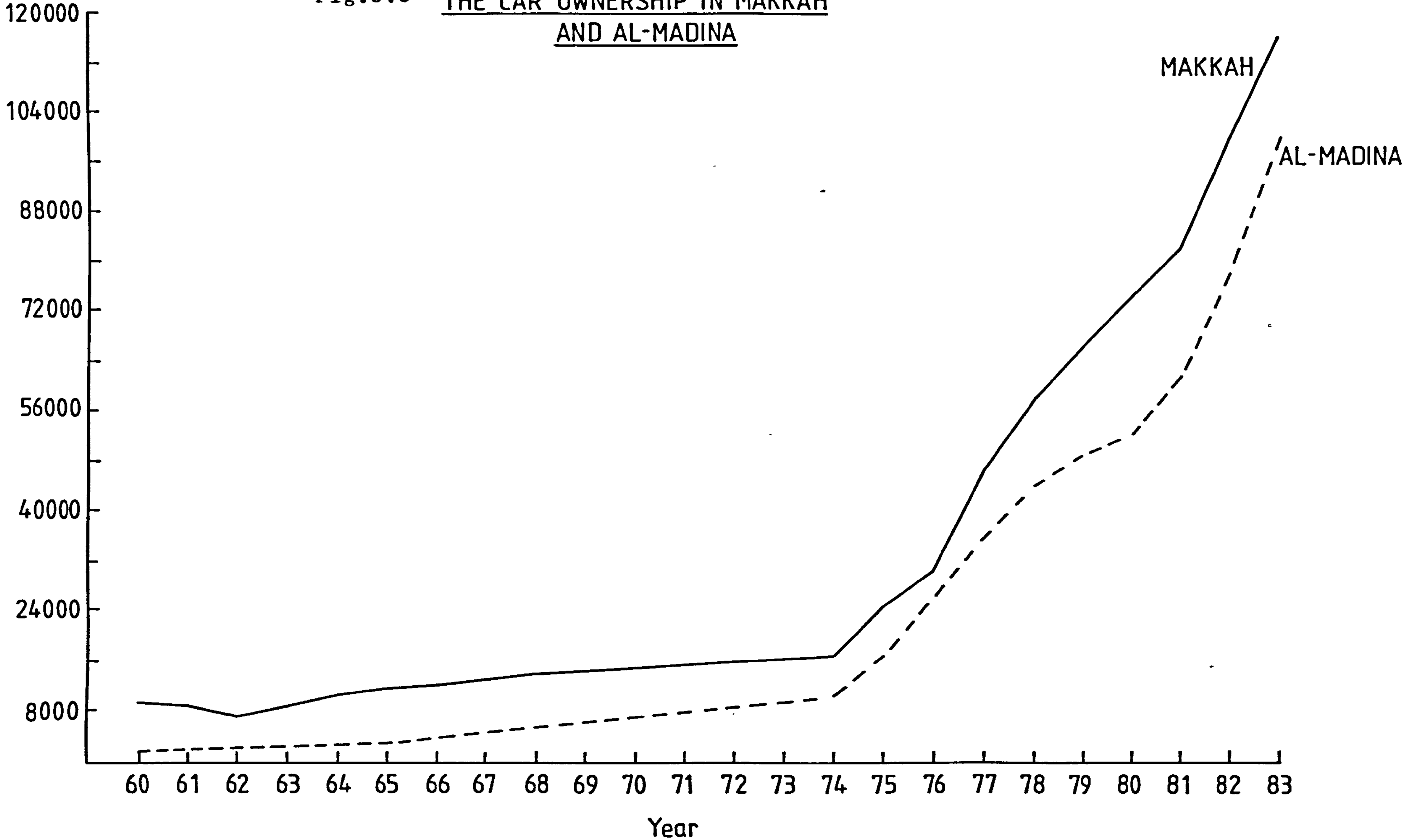
*Figures calculated by the author.

Source:(1)Al-Ruiithii,M.A.1979.The Geography of Saudi Arabia.p35

(2)The population census(Makkah) 1974.p.85 and p.80

(3)AL-Gazawii,1985,Makkah Fi-Shazarat AL-Zahab,revised by Dr.Al-Gamdy.p.58

Fig.3.3 THE CAR OWNERSHIP IN MAKKAH AND AL-MADINA



3.3.1 Survey Method

The survey comprised two elements: the household interview, and the roadside interview, designed to establish details of trips within Makkah, and the nature of car ownership.

3.3.1.1 The Household Interview

The survey was conducted within Makkah's 36 districts and sub-districts, in addition to small villages which were excluded from the survey. The sampling frame and trip origins and destinations were based on the household in Makkah. The chosen time for distributing the survey was between 17.00 and 19.00 hours on weekdays, to maximise the likelihood of the head of the household being at home. The head of the household was asked to provide the trip-making details of every member of his house over ten years of age, for the five preceeding normal weekdays. The absence of the head of the household caused some problems. In this instance, the oldest son was asked to give details. Women and girls could not be interviewed because of the religious prohibition. Refusal to give figures about income prevented any further analysis of this variable.

For each individual, particulars of every "trip" were recorded. These trips were defined as being a journey between any two points. They did not need to be home-based and could be of any duration from a few minutes to several hours. Any number of trips could be accomplished between leaving and returning home. However, the householder did not often give information concerning any non-home based trips because he considered the mention of one trip adequate, which caused difficulty in acquiring more detailed information about trips.

The details requested were: number in household, nationality, age, sex, occupation, place of work and the name of the district where each journey started and finished. If this was unknown, it could be indicated on the interviewer's map. The mode of travel was also asked for each trip, as well as income level and the number of cars owned. The purpose intended as the start of each trip was classified into one of the following: home, social, visit, religious, pleasure, work, health, shopping and others not specified.

A total of 1,200 questionnaires were distributed to the homes in Makkah (population 599,400) [15]. The number of samples is relatively small (1%), because there was not enough time or resources to conduct a bigger survey. The number of samples was divided between the 27 districts and sub-districts of the city, 44 being obtained from each district. This rather crude allocation was necessary since the number of buildings in each district is not known and the houses are not numbered. Thus, samples were taken at random by standing in the middle of the district, locating the four geographical directions and taking 24 houses; 12 from the centre due south and 12 from the centre due north, while 20 samples were taken going west and east. Similar allocations were devised for all the other districts.

Seven hundred samples were returned. After examining them, the valid number of completed answers was 464. The invalid replies were either answered incompletely or were difficult to read. The computer analysis run was therefore based only on the completed and valid samples.

3.3.1.2 Road-side Interviews

First, the road-side interview points were set up. One was to the west of Al-Haram area, on streets leading to the west and south of the city, and the other on Al-Azizah road which leads to the north and east. From these locations it was possible to sample all external traffic to Makkah. Two-lane streets were chosen, using one lane for vehicles whose occupants were being interviewed, while the other lane flowed without interruption. A prominent notice about the census point was erected and the purpose of the interview was explained. The interviews were conducted on normal weekdays from 16.00 to 19.00 hours. The decision as to which vehicles would be interviewed was taken at random and of course depended upon the co-operation of the driver. A supervisor moved between the two points to check that the interviews were conducted correctly. An hour was spent at each point by the supervisor during the interviews. Selected passengers from buses and taxis were also questioned. The information requested from road-side interviews was identical to that requested from the households, to acheive a complete picture of all trips likely to be made by the city population.

Altogether, 1,200 questionnaires were distributed to car drivers, taxi passengers and bus passengers (one passenger per bus being selected) within the city of Makkah. Returned samples reached 850. After checking, the valid number of complete answers was found to be 606, the remainder being invalid due to incomplete answers. The final analysis was obviously limited to those which were complete and valid.

3.3.2 Household Survey Findings

The survey revealed that 22% of Makkah's households have no car, 51.7% have one car, while 26.3% have more than two cars. Thus, it can be said that 78% of the households of the city own cars, which is a high proportion. In addition to this, the study showed that there are differences in car ownership according to district, family size, age, nationality and occupation, as discussed in the following section.

3.3.2.1 Car Ownership by District in Makkah 1985

Car ownership in Makkah 27 districts was found to vary from one district to another. The computer analysis classified three categories: low; middle and high ownership levels. This classification enabled us to make comparisons of car ownership by district.

The study revealed that the number of cars owned is low in the districts around Al-Haram area (Table 3.6). This doubtless

Table 3.6 Car Ownership in Makkah Districts(1985).Based on Sampling

Districts	No. of Vehicles Owned					Row Total	%
	0	1	2	3	+4		
							Low level-around Al-Haram 4.3%
Al-Qararah	2	1	-	-	1	4	0.9
Amir Path	1	1	-	1	-	3	0.6
Al-Shamiah	-	4	2	1	2	9	1.9
Al-Sullimaniah	-	-	2	-	2	4	0.9
							Middle level-new districts 9.3%
Al-Nuzha	-	1	2	1	1	5	1.1
Al-Zahir	1	6	-	-	1	8	1.7
Al-Rassifiah	-	3	2	3	4	12	2.6
Al-Aziziah	2	9	3	2	2	18	3.9
							High levelfar from Al-Haram (1-7 km) 86.4%
Ajiyad	7	14	7	2	1	31	6.7
Al-Missfalh	2	27	2	2	2	35	7.5
Al-Tundbawy	6	13	2	5	3	29	6.2
Al-Hindawiah	-	6	4	2	3	15	3.2
Al-Shabikah	3	9	5	2	4	23	5.0
Harat Al-Bab	4	10	4	3	3	24	5.2
Jarwal	-	-	1	-	-	1	0.2
Al-Utibiah	2	4	-	1	1	8	1.7
Al-Jumizah	6	7	2	2	1	18	3.9
Al-Khasa	4	14	-	-	-	18	3.9
Mina	5	7	4	1	2	19	4.1
Kudi	4	14	1	-	6	25	5.4
Al-Shishah	8	9	1	-	-	18	3.9
Al-Rudah	22	26	3	-	-	51	11.0
Al-Adel	5	15	-	-	1	21	4.5
Jabal Al-Noor	8	12	-	-	1	21	4.5
Al-Faisaliah	10	12	2	-	-	24	5.2
Al-Qashalah	-	16	3	-	1	20	4.3
Column Total	102	240	52	28	42	464	100.0

Source:Fieldwork,Makkah 1985

reflects the small size of the districts compared with other sections of the city (Fig. 3.4) and the low population of these districts (Table 3.7). Population totals in this table represent the year 1983, the only recent figures we have available. The earlier population census of 1974 did not provide district populations. The census of 1963 gave population of city districts, but was unreliable and did not include the new districts which appeared after 1963. No more recent population statistics have been obtained, which prevents a comparison being made between past and present car ownership in Makkah. We shall therefore depend upon our analysis of the figures obtained for 1983.

From Table 3.6 it is seen that many cars are owned in areas located about one to seven kilometers from Al-Haram (Fig. 3.4). This is attributable to the densely built-up areas where buildings rise from three to seven storeys, thereby housing more than one family, resulting in those districts becoming highly populated (Table 3.7). It is clear from Tables 3.6 and 3.7 that Jarwal and Al-Utibah districts have high populations, but the ratio of car ownership is apparently low in these two areas. The survey probably did not truly represent reality however, due to the small number of samples from these two districts.

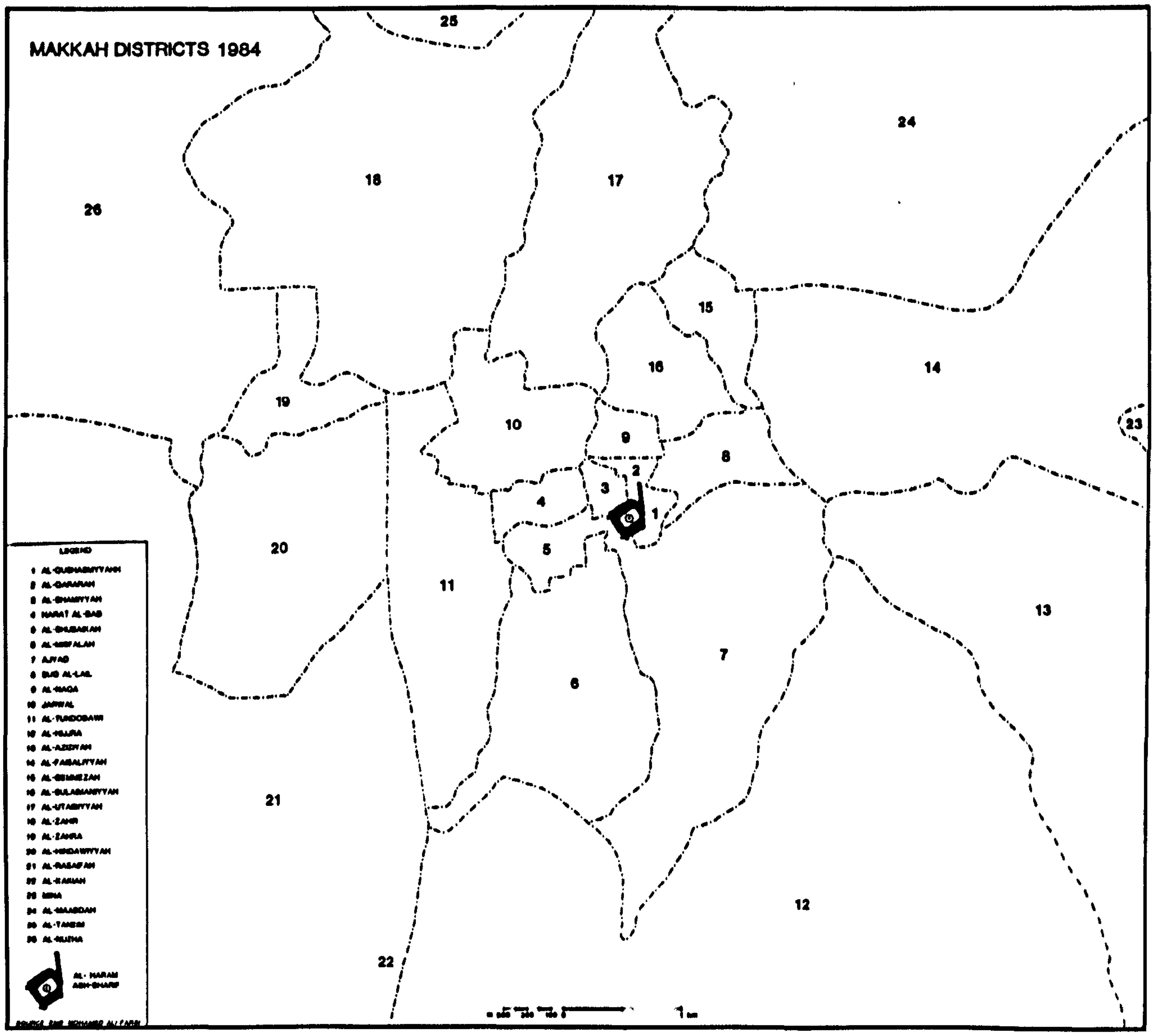

MAKKAH DISTRICTS 1984
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Fig.3.4

Table 3.7 Population of Districts in 1963 and 1983

Districts	Population 1963	Population 1983	Area in Hectares
1 Al-Qushashiah	2163	1700	10.7
2 Ajiyad	10339	24800	386.2
3 Al-Missfalah	22661	77200	1950.0
4 Al-Shibikah	6822	14500	35.5
5 Harat Al-Bab	2933	10900	36.9
6 Al-Shamiah	5291	7300	13.0
7 Al-Qararah	2737	5800	10.5
8 Suq Al-lil	3461	8100	13.6
9 Jarwal	8630	31200	121.7
10 Al-Naqa	3307	6200	21.4
11 Amir Path	11785	24900	82.1
12 Al-Aziziah*	-	13600	2007.6
13 Jabal Al-Noor*	-	-	2015.6
14 Kudi*	-	-	1079.7
15 Al-Tund'bawy	12079	49800	227.5
16 Al-Sullimaniah	5868	10000	51.8
17 Al-Jumizah	11723	9200	621.1
18 Al-Utibiah	11203	62800	421.1
19 Al-Maabdah	9935	31900	2525.2
20 Al-Faisaliah	1725	43600	1632.5
21 Mina	1422	2600	1260.4
22 Al-Rassifiah*	-	6100	2221.0
23 Al-Hindawiah	11080	53400	353.7
24 Al-Zahra	1308	6200	74.0
25 Al-Zahir	11474	45000	805.9
26 Al-Nuzha	963	7700	2513.1
27 Al-Taneem*	-	4900	3238.2

*New districts

Source:(1)Central Department of Statistics,Population Census 1962-63.Ministry of Finance and National Economy, Riyadh,Saudi Arabia.p.35

(2)Al-Gazawi,1985,Makkah Fi Shazarat Al-Zahab,revised Dr.Al-Gamdy,Nadi Makkah Al-Adaby Press,Makkah.p.53

Referring to Table 3.6 it can be seen that the highest numbers of cars are in new districts between the areas around Al-Haram and those furthest from it. Many of the houses in these districts are villas with one family in each villa. This results in a low level of population density and keeps car ownership at moderate levels. The distance between these new districts and the city centre may vary from 9 to 12 kilometres .

A simple correlation analysis was used to examine car ownership and car ownership be district (Table 3.8). Computer analysis showed that there is a significant negative relationship between car ownership and its distribution over Makkah's districts. This clearly reflects the size of population and the income levels.

Table 3.8 Pearson Correlation Coefficients

Variable		District	Family size	Occupation
No. of cars	r	-0.158	0.407	0.040
	sig.	0.001	0.001	-

Source: Fieldwork, Makkah, 1985

3.3.2.2 Car Ownership by Nationality

The study revealed that the Saudis owned 64.9% of all vehicles, much higher than the non-Saudis whose car ownership forms 35.1% of the total (Table 3.9).

The level of car ownership in Makkah among Saudis clearly reflects higher incomes, although it was not possible to determine the level of income among those interviewed. The majority refused to give such details when requested because they regarded it as confidential information. This fact prevented us from examining the correlation between income level and car ownership in Makkah.

3.3.2.3 Car Ownership by Family Size

As a result of the survey analysis in 1985, the mean family size in Makkah was found to be five persons. Thus, in the analysis car ownership is divided into four categories according to family size (Table 3.10). This classification is useful in a comparative analysis of car ownership among city families. Table 3.10 shows that Group 1 has the highest proportion of cars and alone forms 57.2%, while Group 4 is the lowest (1%). The simple Pearson correlation showed a low relationship between family size and the number of cars owned by each family (Table 3.8). So it can be said that income plays a very important role in the trend of car ownership and this will increase or decrease irrespective of family size.

Table 3.9 Car Ownership by Nationality Based on Sampling (1985)

Nationality	Number of Vehicles												Row Total
	0	1	2	3	4	5	6	7	8	9	10	11	
Saudi	28	158	48	27	20	6	3	6	1	2	1	1	301 64.9+
Non Saudi	74	82	4	1	-	-	-	-	-	1	1	-	163 35.1+
Column Total	102 22.0*	240 51.7	52 11.2	28 6.0	20 4.3	6 1.3	3 0.6	6 1.3	1 0.2	3 0.6	2 0.4	1 0.2	464 100.0

+ Percentage *Percentage of column total

Source:Fieldwork,Makkah 1985

Table 3.10 Car Ownership by Family Size Based on Sampling (1985)

	Family Size	Number of Vehicles 0	1	2	3	+4	Row Total	%
1	1-5	80	157	17	4	7	265	57.2
2	6-10	17	68	28	22	21	156	33.62
3	11-15	5	15	5	1	12	38	8.18
4	16+	-	-	2	1	2	5	1.0
Column Total		102	240	52	28	42	464	100.0
%		22.0	51.72	11.20	6.03	9.05		100.0

Source:Fieldwork,Makkah 1985

3.3.2.4 Car Ownership by Age, Makkah 1985

In the survey conducted in Makkah, the age range was found to vary from 18 to 65 years or more, but has been classified into four groups to simplify the analysis (Table 3.11). Car ownership clearly varies according to age of respondent. Group 1 contains the youngest age group (18-32 years) and has the highest level of car ownership (58.8%) while Groups 2, 3 and 4 have 22.7%, 11% and 2.8% respectively.

The reason for the high level of car ownership in Groups 1 and 2, together forming 86.2% of the total, is the fact that in the age structure of the Saudi Arabian population there are more in the younger cohorts, with the number of old and middle-aged cohorts forming a smaller proportion (16). Thus, it is not surprising that car ownership in Groups 1 and 2 is higher than in the other groups. Additionally, the age groups mentioned above form the actively employed population who generally enjoy good incomes (17). The use of the Pearson correlation showed that a marked low relationship exists between car ownership and age (Table 3.8).

3.3.2.5 Car Ownership by Occupation

The data obtained from the socio-economic in 1985 showed that the range of employment in Makkah is very wide, and can be classified into seven groups (Fig. 3.5), with the seventh headed "Others", eg. seasonal work during the Hajj, office boys who prepare tea for customers or clean offices, and the caretakers of

Table 3.11 Car Ownership by age in Makkah(1985)Based on sampling

Group Number	Age Group	Number of Vehicle Owned					Row Total	%
		0	1	2	3	+4		
1	18-32	63	142	34	17	17	273	58.8
2	33-47	29	73	13	2	10	127	27.4
3	48-62	7	23	4	7	10	51	11.0
4	62+	3	2	1	2	5	13	2.8
Column Total		102	240	52	28	42	464	100.0
%		22.0	51.72	11.20	6.03	9.05		100.0

Source:Fieldwork,Makkah 1985

buildings. The aim of Fig. 3.5 is to simplify the comparison of car ownership in relation to occupation of the respondent.

The study revealed that car ownership is very high in the first three groups (Table 3.12) where it reaches 38%, 24.6% and 21.5% respectively. In contrast, car ownership forms a low proportion in Groups 4 to 7, the highest being in Group 4 (8.2%). The reason why the first group is the highest is probably due to the high income and geographical dispersion of offices in Makkah. Also, the self-employed may not wish to travel by public transport as it does not provide a convenient link between home and office. Table 3.12 also shows car ownership to be high in Group 2 since a car is necessary for travelling to work and also for transporting tools and equipment to the place of work (eg. building site, private house etc.).

Group 3 possibly has a high level of car ownership due to the location of higher education institutions. The university lies on the eastern outskirts of the city and cannot be reached directly by public transport. The cost of the bus fare is also very high, particularly if the student has to change in the Al-Haram area. A return journey could cost SR 8 (£1.15 at the rate of £1.00 = SR 6.95) per day. This amount is more than sufficient to buy petrol and run a car for a week, for the journey between home and university.

Using the Pearson correlation, showed that no significant relationship exists between car ownership and occupation, and the correlation between the variables mentioned above is very low.

Fig.3.5 Occupations identified in the socio-economic survey in Makkah (1985)

(1)Government Employees

Teacher	Engineer	Accountant	Officer
Government Official	Surveyor	Journalist	Soldier

(2)Manual Workers

Worker	Carpenter	Plumber	Driver	Tailor
Builder	Painter	Electrician	Tinsmith	

(3)Student

School Student	University Student

(4)Self-employed

Goldsmith	Photographer	Businessman

(5)Health Sector

Doctor	Dentist

(6)Retired

(7)Others

Mottawaif (pilgrim Guide)	Office Boy	Stand Keeper

Source:Fieldwork,Makkah 1985

Table 3.12 Car Ownership by Occupation of Head of Household (1985)Based on Sampling

Group No.	Occupation	Number of Vehicles Owned					Row Total	%
		0	1	2	3	+4		
1	Government Employee	15	113	26	9	13	176	38.0
2	Manual Workers	60	46	3	1	4	114	24.6
3	Student	19	47	17	10	7	100	21.5
4	Self-employed	5	13	2	4	14	38	8.2
5	Health sector	-	2	-	-	-	2	0.4
6	Retired	3	2	-	1	1	7	1.5
7	Others	-	17	4	3	3	27	5.8
Column Total		102	240	52	28	42	464	100.0
%		22.0	52.72	11.20	6.03	9.05		

Source:Fieldwork,Makkah 1985

The only explanation must be that income level is once again the dominant factor affecting the level of car ownership. Also, the correlation may be low since students are classified as an occupational group although they have neither jobs nor income.

3.4 Trip Generation

As is evident from the above discussion, car ownership in Makkah is very high. The following section explores how far the car influences the habits of population mobility among city dwellers. When animal transport or walking were the only method, mobility was restricted. Today, however, patterns of mobility are of extraordinary complexity as noted by Daniels:

> "... because most of the activities which attract or produce trips cannot be spatially correlated, and hence people and goods must move from one point in the city to another; from home to work, from work to business appointment, from home to shop, from factory to warehouse or from warehouse to retailer or manufacturer. The range of possibilities is endless and the resulting web of travel is complex because it varies both in space and time." (P.W. Daniels) (18)

3.4.1 Origin and Purposes

Tables 3.13.1 to 3.13.8 illustrate the origin and destination for each individual trip, originating in each of the Makkah city districts, from the socio-economic survey in 1985. Origin and destination purposes are grouped similarly into home, visit, work, market, religious, pleasure, health and "others". The study revealed not unexpectedly that the dominant origin is home, while trip purposes vary enormously. This aspect will be discussed in another section.

Table 3.13.1 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Religious	Pleasure	Health	Others
Al-Qararah	Home	4		2						2
	Visit									
	Work									
	Market									
	Religious	1			1					
	Pleasure									
	Health									
	Others									
Total		5		2	1					2
Amir Path	Home	3		2	1					
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		3		2	1					
Ajiyad	Home	31	1	6	9	7				10
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health	2								
	Others									
Total		33	1	6	9	7				10
Al-Missfalah	Home	34		9		7		2		18
	Visit	4					4			
	Work	3	2		1					
	Market	1								1
	Religious									
	Pleasure									
	Health									
	Others	1								1
Total		43	2	9	1	7	4	2		18

Source: Fieldwork, Makkah 1985

Table 3.13.2 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Religious	Pleasure	Health	Others
Al-Tundbawy	Home	25		3	10					12
	Visit									
	Work	4	2			2				
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		29	2	3	10	2				
Al-Hindawiah	Home	15			8	2	2	1		2
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		15			8	2	2	1		2
Al-Shabikah	Home	23		3	7	2	1		3	7
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		23		3	7	2	1		3	7
Harat Al-Bab	Home	24		3	11	3	4			3
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		24		3	11	3	4			3

Source: Fieldwork, Makkah 1985

Table 3.13.3 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Religious	Pleasure	Health	Others
Jarval	Home	1	1							
	Visit									
	Work	1			1					
	Market	2				2				
	Religious									
	Pleasure									
	Health									
	Others									
Total		4	1		1	2				
Al-Nuzha	Home	5		1	3		1			
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		5		1	3		1			
Al-Zahir	Home	8			3	3	2			
	Visit									
	Work	2	1					1		
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		10	1		3	3	2	1		
Al-Utaibiah	Home	8	1	1	2	1	2	1		
	Visit									
	Work	1								1
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		9	1	1	2	1	2	1		1

Source: Fieldwork, Makkah 1985

Table 3.13.4 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Religious	Pleasure	Health	Others
Al-Sullimaniah	Home	4			1	2	1			
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others	1								1
Total		5			1	2	1			1
Al-Shamiah	Home	9		2	3					4
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		9		2	3					4
Al-Jumizah	Home	9			5	1		3		
	Visit									
	Work	1					1			
	Market	2					2			
	Religious	1					1			
	Pleasure									
	Health									
	Others									
Total		13			5	1	4	3		
Al-Khansa	Home	11			4	2	5			
	Visit									
	Work									
	Market									
	Religious									
	Pleasure	1							1	
	Health									
	Others	1							1	
Total		13			4	2	5		2	

Source: Fieldwork, Makkah 1985

Table 3.13.5 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Religious	Pleasure	Health	Others
Al-Aziziah	Home	18	7	2	8	1				
	Visit	1					1			
	Work	2					2			
	Market	1				1				
	Religious									
	Pleasure	3						3		
	Health	1					1			
	Others	8					1			7
Total		34	7	2	8	2	5	3		7
Muna	Home	19		1	7	3	7			1
	Visit									
	Work									
	Market									
	Religious									
	Pleasure	4								4
	Health									
	Others									
Total		23		1	7	3	7			5
Kudi	Home	24		2	10	2	3			7
	Visit									
	Work	1						1		
	Market									
	Religious									
	Pleasure									
	Health									
	Others									
Total		25		2	10	2	3	1		7
Al-Rassifiah	Home	12	2		9					1
	Visit									
	Work	1								1
	Market									
	Religious									
	Pleasure									
	Health									
	Others	2								2
Total		15	2		9					4

Source: Fieldwork, Makkah 1985

Table 3.13.6 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Religious	Pleasure	Health	Others
Al-Shishah	Home	5	3			2				
	Visit	1		1						
	Work	1			1					
	Market	1			1					
	Religious	1			1					
	Pleasure									
	Health	2					2			
	Others	1							1	
Total		12	3	1	3	2	2		1	
Al-Rudah	Home	9	7							2
	Visit	1		1						
	Work	4					4			
	Market	5								5
	Religious	6			6					
	Pleasure									
	Health	1			1					
	Others	8						3	5	
Total		34	7	1	7		4	3	5	7
Al-Adel	Home	2			2					
	Visit									
	Work	6	4						2	
	Market									
	Religious									
	Pleasure									
	Health									
	Others	1					1			
Total		9	4		2		1		2	
Al-Qashalah	Home	6		1	3		2			
	Visit									
	Work									
	Market									
	Religious									
	Pleasure									
	Health									
	Others	1				1				
Total		7		1	3	1	2			

Source: Fieldwork, Makkah 1985

Table 3.13.7 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Reli-gious	Plea-sure	Health	Others
Jabal Al-Noor	Home	4			1		3			
	Visit									
	Work									
	Market									
	Reli-gious									
	Plea-sure									
	Health									
	Others									
Total		4			1		3			
Al-Faisaliah	Home	17			13		4			
	Visit									
	Work	1								1
	Market	2								2
	Reli-gious									
	Plea-sure	3						2		1
	Health									
	Others	2				2				
Total		25			13	2	4	2		4
Al-Naqa	Home									
	Visit									
	Work	1	1							
	Market									
	Reli-gious									
	Plea-sure									
	Health									
	Others									
Total		1	1							
Al-Maabdah	Home									
	Visit	1			1					
	Work	7	6		1					
	Market	4			4					
	Reli-gious	3								3
	Plea-sure	1			1					
	Health	4					4			
	Others									
Total		20	6		7		4			3

Source: Fieldwork, Makkah 1985

Table 3.13.8 Trips by Origin

Origin	Origin Type	Total	Home	Visit	Work	Market	Reli-gious	Plea-sure	Health	Others
Al-Haram Area	Home									
	Visit									
	Work									
	Market									
	Reli-gious	1	1							
	Plea-sure									
	Health									
	Others									
Total		1	1							
Al-Qushashiah	Home									
	Visit									
	Work	1	1							
	Market	1					1			
	Reli-gious									
	Plea-sure									
	Health									
	Others									
Total		2	1				1			
Al-Shohadaa	Home									
	Visit									
	Work	5	4			1				
	Market									
	Reli-gious									
	Plea-sure									
	Health									
	Others	1					1			
Total		6	4			1	1			
Al-Taneem	Home									
	Visit									
	Work	2	2							
	Market									
	Reli-gious									
	Plea-sure									
	Health									
	Others	1		1						
Total		3	2	1						

Source: Fieldwork, Makkah 1985

3.4.2 Trips to Work

In the socio-economic survey, the place of work was ascertained in order to establish not only which districts produce the most journeys to places of work, but also to determine which districts attract the highest number of journeys, including those from outside the city. This helps to establish the flow of traffic associated with work in Makkah. It was intended that journeys to school would be covered by the survey, but at the time it was conducted there was a national holiday for all schools, though not at the university.

Saudi Arabia's working hours differ from those of Great Britain which are largely fixed throughout the year, and may be typified as 09.00 to 17.00. In Saudi Arabia, working hours vary according to season. In winter the hours are from 08.00 to 14.00 (to ensure that the weather is warm enough for people to work outside) and in summer they are from 07.30 to 13.30 (thereby avoiding the heat of the sun in the middle of the day, when temparatures average 40°C). Such working hours in Saudi Arabia apply to all government officials, students and occupations previously classified (Table 3.12), but the working hours for occupations such as builders, painters, businessmen, traders and all jobs classified in Group 2 (Table 3.12) usually have another shift which runs from 16.30 to 19.00. Traders and businessmen also have the freedom to work from 08.00 to 20.00 with a break between 14.00 and 16.00 (the hottest part of the day). Since government officials in Saudi Arabia usually work without a break, they make only five trips a week to work, whereas in Britain they may go out for lunch, thereby generating more trips (19). There are two traffic peaks in Makkah, one in the morning and the other in the afternoon. Another journey to work peak is caused by those who work after 16.00.

Table 3.14 illustrates the journeys to work between districts in the city of Makkah and those produced from within the city, but having destinations outside it. The most significant area for attracting journeys to work is Al-Haram, which accounts for 22.8% of the total journeys to work. This is no doubt because it incorporates the city centre, comprising the Haram, the commercial area, and also certain public utilities, schools and government offices. Al-Maabdaa district on the other hand attracts only 8.6% of the total journeys to work. The other districts account for the remainder varying in percentage from 0.2% to 6%. It can be ascertained from the Table that some journeys to work started and finished in the same district, indicating that the place of residence and work are near one another. The Table also illustrates that work places outside Makkah attract a total of 4.9% of the total journeys to work, with the city of Jeddah alone accounting for 4.1% of the total. Nevertheless, comparing journeys to work in and outside the city of Makkah, the percentage is found to be far higher in the city with a total of 95.1%.

Table 3.14 Trips To Work in Makkah 1985

Journey Origin	Place of Work Inside Makkah																																Place of Work Outside Makkah				Row Total	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	26	27	28	29	30	31	33	34	35	41	42	43	45		
Al-Qararah	1	1	0	0	1	0	0	0	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	.9
Amir Fath			1																			1										1					3	.6
Ajiyad	16					2	1	1	1		1				1					1		2										1		4			31	6.7
Al-Kiasfalah	16					2			9					1						1														4	1		35	7.5
Al-Tundbawy	8	2					2	8							2					1					2							3		1			29	6.3
Al-Hindawiah	4				1		1						1		1				1	1		1										3		1			15	3.2
Al-Shabikah	10				3			1		3					1							1										1		3			23	5.0
Harat Al-Bab	6					1	1	1		1	7	1		1	2											1						1		1			24	5.2
Jarwal												1																									1	.2
Al-Nuzha	1									1				2																		1					5	1.1
Al-Zahir					3									1	1	2									1												8	1.7
Al-Utaibiah	1				1										1					1		1												2		1	8	1.7
Al-Sullimaniah	1				1																							1						1			4	.9
Al-Shamiah	1									1		1			1		1	2												1		1					9	1.9
Al-Jumizah	1											1		1					2	7		2					1	1			1	1					18	3.9
Al-Khansa									1			1		1	1	1				3	1	1				2				4	1	1					18	3.9
Al-Aziziah	5				1				1						1					2		7												1			18	3.9
Muna	4								1													1	12							1							19	4.1
Kudi	4				3		3	1						3	2	2			1	1				4										1			25	5.4
Al-Rusaifiah	4				2							1		1	1										3												12	2.6
Al-Shishah	5				1										1				1	1		1				4	1	2		1							18	3.9
Al-Rudah	7						3	1				1		1	1	1	3		1	9	1	1			2	3	8	3	1	3		1	1				51	11.0
Al-Adel	2				1							1		1	1					1		4					8	8		2	2						21	4.5
Al-Qashalah						1	1	1				1	1	1	1					5		3			1			2	1		1	1					20	4.3
Ja al Al-Noor	7											1		1					1	3						1		1		4		2					21	4.5
Al-Faisaliah	2				1		1													3		2			1	1	1				11		1				24	5.2
	106	3	1	0	19	6	13	14	13	6	8	10	3	15	19	6	5	2	8	40	2	28	12	4	10	12	11	18	2	14	15	16	2	19	1	1	464	100.0
	228	6	.2	.0	41	13	28	30	28	13	17	22	6	32	41	13	11	4	17	86	4	60	26	9	22	26	24	39	4	30	32	34	4	41	2	2		

Source: Fieldwork, Makkah 1985

Key to District Numbers in Tables 3.14 and 3.15

1 Al-Haram Area
2 Al-Qararah
3 Amir Path
4 Suq Al-lil
5 Al-Qushashiah
6 Ajiyad
7 Al-Missfalah
8 Al-Tund'bawy
9 Al-Hindawiah
10 Al-Shabikah
11 Harat Al-Bab
12 Jarwal
13 Al-Zahara
14 Al-Nuzha
15 Al-Zahir
16 Al-Utaibiah
18 Al-Naqa
19 Al-Shamiah
20 Al-Jumizah
21 Al-Maabdah
22 Al-Khansa
23 Al-Aziziah
24 Mena
26 Kudi
27 Al-Rassifiah
28 Al-Shisha
29 Al-Rudah
30 Al-Adel
31 Al-Qashalah
32 Jabal Al-Noor
33 Al-Hajj Street
34 Al-Faisaliah
35 Al-Taneem
36 Al-Awaly
40 Arafat
41 Al-Sharaiia
42 Jeddah
43 Numaan Valley
45 Bahrah

3.4.3 The Population Mobility Between Districts

Table 3.15 depicts the internal movement of people between the districts of the city. Of the total daily trips (464) made in Makkah, nearly 9% were destined for Al-Haram area, according to the survey.

The "desire-line" diagram (Fig. 3.6) is produced by assuming that all trips are generated by, or are attracted to, the centre of each district (home) and drawing lines between the originating and destined point. Since the origin-destination matrices provide complete information only on wholly internal trips, all internal-external (ie. to Jeddah) and external-internal trips are ignored.

From the diagram it can be seen that districts south and south-west and west of Al-Haram generate a high ratio of trips, while districts north and north-east of Al-Haram generate fewer trips.

3.4.4 Trips by Purposes

Table 3.16 illustrates the trips by grouped purposes. Of the total 464 trips, 78 (16.8%) were home-based work trips (HBW), either starting or ending at home. Another 250 (53.9%) non-work trips were also home-based (HBNW). The remaining 135 (29.3%) trips were non-home-based (NHB), not necessarily ending at home.

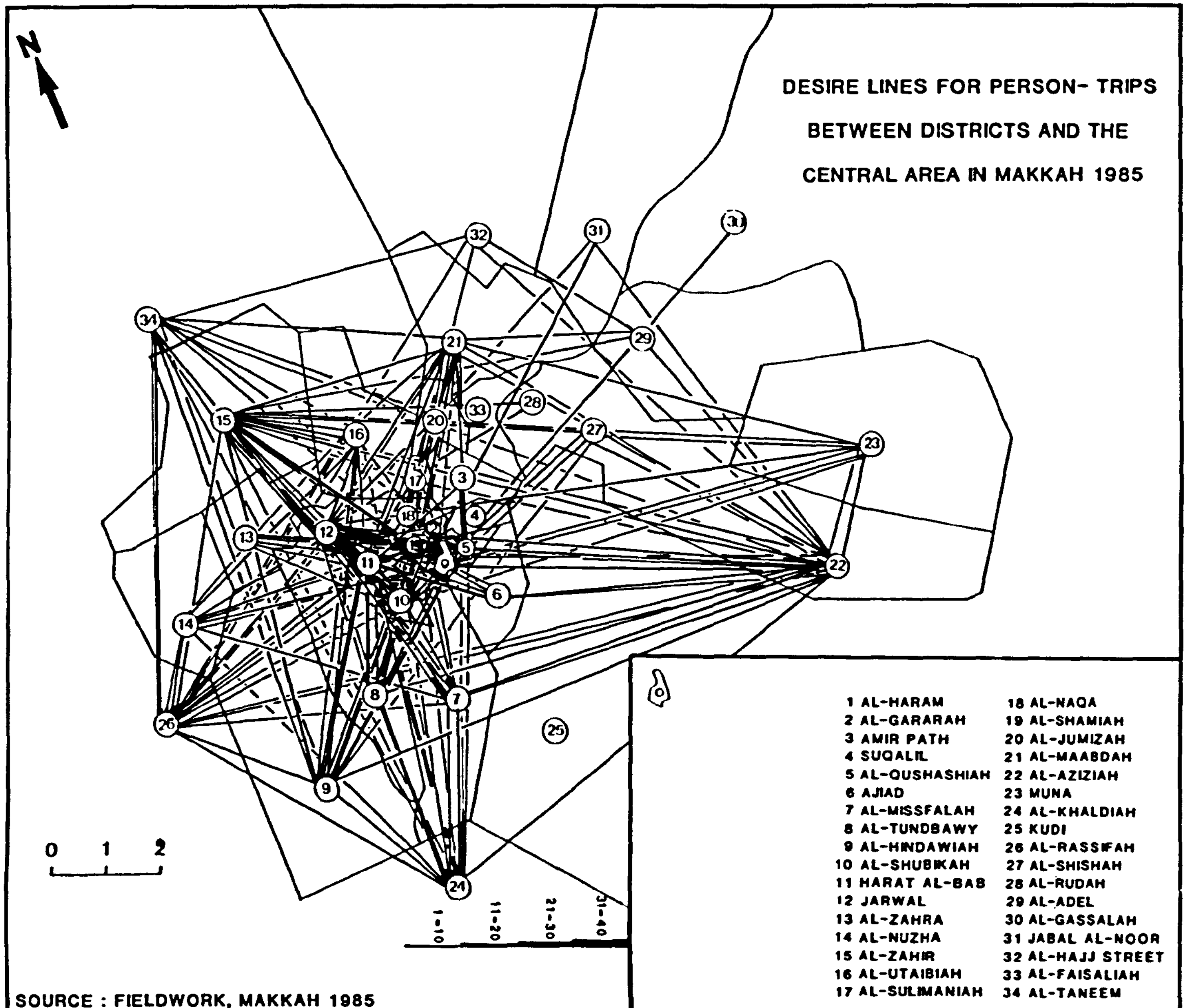
DESIRE LINES FOR PERSON- TRIPS
BETWEEN DISTRICTS AND THE
CENTRAL AREA IN MAKKAH 1985
N
0 1 2
1-10
11-20
21-30
31-40
1 AL-HARAM
2 AL-GARARAH
3 AMIR PATH
4 SUQALIL
5 AL-QUSHASHIAH
6 AJIAD
7 AL-MISSFALAH
8 AL-TUNDBAWY
9 AL-HINDAWIAH
10 AL-SHUBIKAH
11 HARAT AL-BAB
12 JARWAL
13 AL-ZAHRA
14 AL-NUZHA
15 AL-ZAHIR
16 AL-UTAIBIAH
17 AL-SULIMANIAH
18 AL-NAQA
19 AL-SHAMIAH
20 AL-JUMIZAH
21 AL-MAABDAH
22 AL-AZIZIAH
23 MUNA
24 AL-KHALDIAH
25 KUDI
26 AL-RASSIFAH
27 AL-SHISHAH
28 AL-RUDAH
29 AL-ADEL
30 AL-GASSALAH
31 JABAL AL-NOOR
32 AL-HAJJ STREET
33 AL-FAISALIAH
34 AL-TANEEM
SOURCE : FIELDWORK, MAKKAH 1985
Fig.3.6

Table 3.15 Trip Interchange Matrix - Personal Trips Between Districts of Makkah

Origin Districts	Destination Districts																																		Row Total	%
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34	35	40	41	42		
Al-Haram Area																												1								1.	.2
Al-Qararah		1		1			1									1		1																		5	1.1
Amir Fath			2																		1															3	.6
Al-Qushashiah																			1										1							2	.4
Ajiyad				5	1	3	2	2		1	1			3	1	1					6		2	2			2					1				33	7.1
Al-Missfalah				1	2	12	1	1	1		1		3	2			1		2		3		2	6		3	1				1					43	9.3
Al-Tundbawy	1			1	1	.1	7	1			5		2	1					1				1	2			1	1		1		2				29	6.3
Al-Hindawiah	2			2		1						1	1	1					1		3											3				15	3.2
Al-Shabikah	1			2		1	3		4		2			3							4			2								1				23	5.0
Harat Al-Bab	4			2	1	1	1		1	3	4		1	2										1								2				24	5.2
Jarwal											1									1							2									4	.9
Al-Nuzha	1												3																			1				5	1.1
Al-Zahir	2			1							1		1	1	1										1	1							1			10	2.2
Al-Uteibiah	2										1			1	2					1													1		1	9	1.9
Al-Sulliemanieh				1												1								1				1			1					5	1.1
Al-Noga																										1										1	.2
Al-Shasiah				1										1		1	3				1									1		1				9	1.9
Al-Jumizah	3																	2	1	2										1	1					13	2.8
Al-Maabdah	3					1												3	1	1					1	2	1	4	2	1						20	4.3
Al-Khansa	3											1						1	4						4	1				2						13	2.8
Al-Aziziah	5			2												1			2		9				1	3	2	1	3				5			34	7.3
Muna	5			1															1		3	9				1				1	2					23	5.0
Kudi	3			2		2	2				1	1	3	2	2			1	1		1		2	1								1				25	5.4
Al-Rossifah				2							1		1	1										7		2				1						15	3.2
Al-Shisheh	1																	1	1							6	1	1	1							12	2.6
Al-Rudah	1					2							1						6	1				2	6	8		1	2		3		1			34	7.3
Al-Adel																					1				2	1	1	2	1		1					9	1.9
Al-Qashalah	1				2													1	1					1		1										7	1.5
Jabal Al-Noor	1																		1						1					1						4	.9
Al-Shohadaa																				1					1	1			2		1					6	1.3
Al-Faisaliah	1				1	1												1	1		2	1				2	1				11	1	1	1	1	25	5.4
Al-Tanzeem						1																							2							3	.6
	40	1	2	24	8	26	17	4	6	4	18	3	16	18	6	5	4	11	25	7	34	10	7	25	18	33	12	12	14	9	21	13	9	1	1	464	100.0

Source: Fieldwork, Makkah 1985

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Table 3.16 Trip by purpose

Trip purpose		Number of trips	%
Home-Based Work	(HBW)	78	16.8
Home-Based Non-Work	(HBNW)	250	53.9
Non-Home-Based	(NHB)	136	29.3
Total		464	100.0

Source: Fieldwork, Makkah 1985

3.4.5 Trip Purpose: Destination

The purpose for each person's trip was recorded and classified according to one of seven groups, plus "others" for those not specified. The purposes shown in Table 3.17 are those for which the trip was made, ie. they are destination purposes.

It is notable that among the eight categories of trip purpose, the work trip (30%) is the most significant purpose of destination. The religious purpose constitutes only 13.8% of the total trips made, and shopping has virtually the same percentage, 11.4%. Return trips to home form only 9.9%, while those for social visits are much the same at 9.3%. Pleasure trips form only 4.1% which is perhaps not surprising since the survey took place during week days. The health purpose forms 2.8%, which includes people travelling to hospital.

Table 3.17 Trip Purpose:Destination

Purpose of Trip	Number of Trips	%
Home	46	9.9
Social visit	43	9.3
Work	134	28.9
Market	53	11.4
Religious	64	13.8
Pleasure	19	4.1
Health	13	2.8
Others	92	19.8
Total	464	100.0%

Source:Fieldwork,Makkah 1985

3.4.6 Trips by Land Use

Tables 3.18.1 and 3.18.2 present origin and destination by land use. Not surprisingly, the biggest producer and attracter of trips was the place of normal residence (home), where about 80% of trips started and 20% ended. Other major producing and attracting land uses were the University, and retailing activities.

3.5 Characteristics of Journeys

The focus of this section is to establish the characteristics of journeys by two elements: the mode of travel and the travel time of trips in the city of Makkah.

3.5.1 Mode of Travel

Table 3.19 gives a breakdown of all trips by mode of travel. It can be seen that 17.5% of trips were undertaken on foot and 1.11% to 6.9% by motorcycle and bicycle respectively. The use of public transport accounted for 7.3%. Taxis accounted for another 2.8% of trips, the remaining 70.5% being made by private car. The most significant feature in mode of travel is the extensive use of private cars.

Table 3.18.1 Trips by Land Use

	Land Use	Trip Origin Number	%
1	Shop	9	1.9
2	Mosque	13	2.8
3	Coffee-house	12	2.6
4	Street	15	3.2
5	House	328	70.7
6	Establishment	9	1.9
7	Supermarket	16	3.4
8	University	21	4.5
9	Studio	1	.2
10	Bakery	3	.6
11	Factory	3	.6
12	Hospital	6	1.3
13	Vegetable Market	3	.6
14	Company	2	.4
15	Government Office	8	1.7
16	Workshop	3	.6
17	Gas Station	3	.6
18	Newspaper Office	1	.2
19	Car Exhibition	1	.2
20	Market	3	.6
21	Main Bus Station	1	.2
22	Post Office	1	.2
23	Al-Haram	2	.4
	Total	464	100.0

Source: Fieldwork, Makkah 1985

Table 3.18.2 Trips by Land Use

Land Use	Trip Destination Number	%
Government office	51	11.0
Commercial house	10	2.2
Coffee house	15	3.2
University	58	12.5
Company	11	2.4
Decorating shop	1	.2
House	94	20.3
Stationery	4	.9
Greengorcery	16	3.4
Street	6	1.3
Mosque	25	5.4
Workshop	10	2.2
Pharmacy	1	.2
Hospital	14	3.0
Barber shop	2	.4
Establishment	25	5.4
Al-Haram	40	8.6
Shop	28	6.0
Gas station	1	.2
Market	30	6.5
Public park	1	.2
Studio	2	.4
Supermarket	1	.2
Play land	2	.4
Doctor	1	.2
Hotel	2	.4
Vegetable market	5	1.1
Bank	2	.4
Main bus station	2	.4
Restaurant	1	.2
Travel agency	4	.8
Total	464	100.0

Source: Fieldwork, Makkah 1985

Table 3.19 Method of travel

Mode	Number of trips	%
Private car	327	70.5
Foot	81	17.5
Motorcycle	5	1.1
Bicycle	4	0.9
Taxi	13	2.8
Bus	34	7.3
Total	464	100.0

Source: Fieldwork, Makkah 1985

3.5.2 Journey Time

In the survey, the time of the trip was asked and also the duration of each trip. The origin-destination computer analysis for each hour of the day indicates distinct peak hours. These are from 07.00 to 08.00 and from 09.00 to 12.00. The time of these peaks was unusual and may have occurred due to the fact that the survey was carried out during school holidays. There is also a peak from 13.00 to 14.00 when employees and workers are returning home, and from 16.00 to 19.00, reflecting the habits of the city population and those who have another work shift. This peak is also due to the preference of people to go out, when the temperatures are lower.

Regarding the length of time taken for trips, the study revealed that the time taken varied from five minutes to an hour or more. This related to the distance between the two points and the method of transportation used. Short trips were usually made within the home district.

3.6 Roadside Interview Analysis

This type of survey was conducted in the city of Makkah and questions asked were similar to those in the socio-economic household survey. This was to establish a more complete picture of population movement. The study revealed that there are significant centroids generating trips, namely: Harat Al Bab, Jarwal, Al-Nuzha, Al-Zahir, Al-Shamiah, Al-Aziziah and Al-Risifiah. These districts are considered the most dominant focal points in producing trips (Fig. 3.7), while the central points attracting most trips are Al-Haram area, Al-Shabikah, Jarwal, Al-Maabdah, Al-Aziziah and Al-Risifiah. It can be seen from the Figure 3.7 that some centroids play a significant role in generating and attracting trips from each other. There is, however, a distinct discontinuity in trips mainly through the city centre and the Haram area. Trips from regions north of the city are likely to be made to other northern areas. The same is true of areas south of the city centre. It can also be seen from

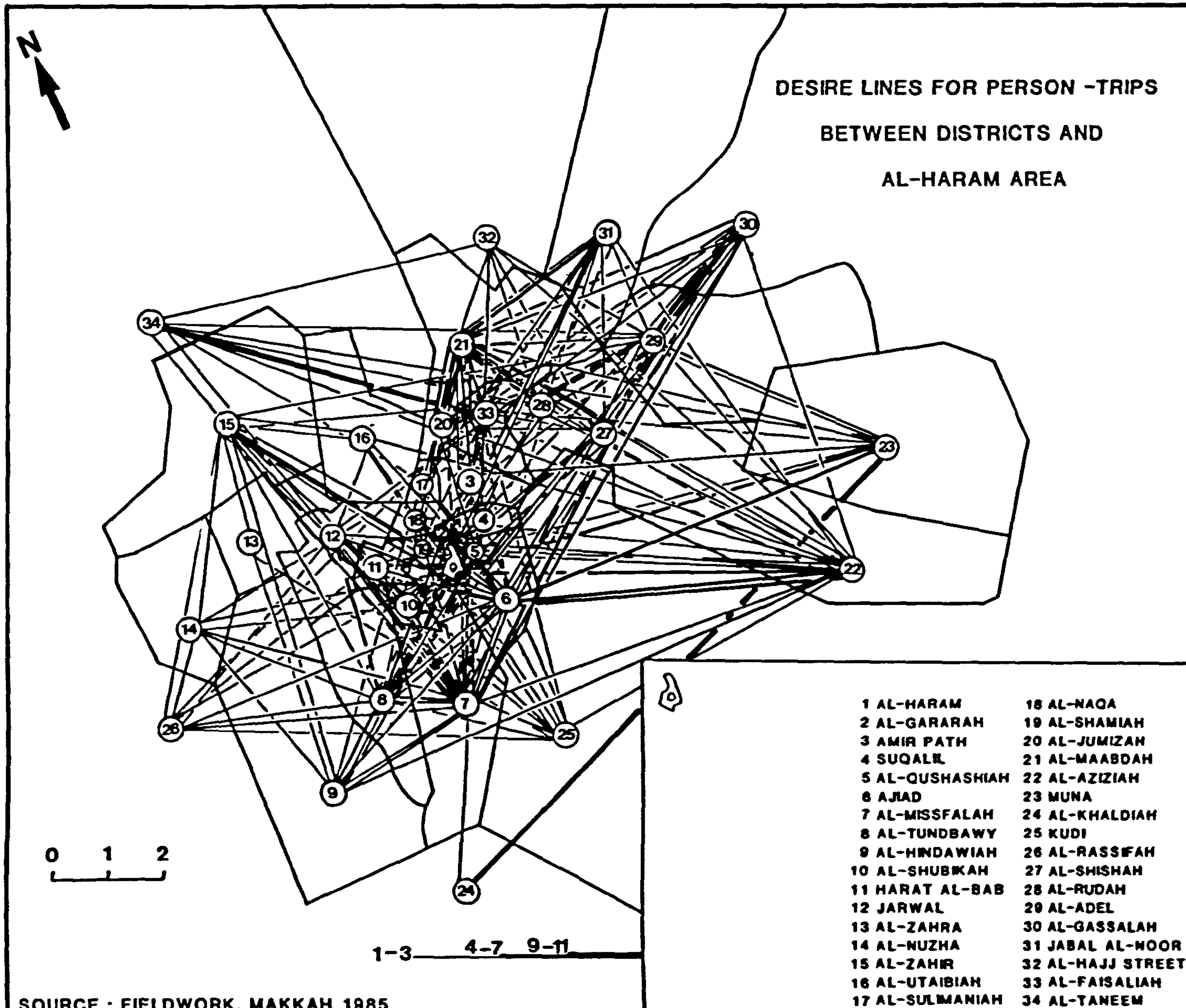
DESIRE LINES FOR PERSON -TRIPS
BETWEEN DISTRICTS AND
AL-HARAM AREA
N
0 1 2
1-3 4-7 9-11
SOURCE : FIELDWORK, MAKKAH 1985
1 AL-HARAM
2 AL-GARARAH
3 AMIR PATH
4 SUQALIL
5 AL-QUSHASHIAH
6 AJIAD
7 AL-MISSFALAH
8 AL-TUNDBAWY
9 AL-HINDAWIAH
10 AL-SHUBIKAH
11 HARAT AL-BAB
12 JARWAL
13 AL-ZAHRA
14 AL-NUZHA
15 AL-ZAHIR
16 AL-UTAIBIAH
17 AL-SULIMANIAH
18 AL-NAQA
19 AL-SHAMIAH
20 AL-JUMIZAH
21 AL-MAABDAH
22 AL-AZIZIAH
23 MUNA
24 AL-KHALDIAH
25 KUDI
26 AL-RASSIFAH
27 AL-SHISHAH
28 AL-RUDAH
29 AL-ADEL
30 AL-GASSALAH
31 JABAL AL-NOOR
32 AL-HAJJ STREET
33 AL-FAISALIAH
34 AL-TANEEM

Fig.3.7

the Figure that the destination of the majority of trips is Al-Haram, indicating the significance that the main mosque (Al-Haram) plays in attracting trips since most of the city's population is accustomed to praying daily at Al-Haram.

3.6.1 Journey Time Based on Roadside Interviews

The only peak which we were able to observe was the evening peak, since most of our team were students who had to attend summer courses at the university during the mornings. This also prevented us from counting the through traffic at the time of the survey, but in spite of that we observed the flow through the two stations mentioned above (south of Al-Haram and north of Al-Haram).

Observations show that the evening peak has a significant flow before and after prayer time with only a small flow during it. The Haram area attracts a great volume of traffic from all areas at prayer time.

The weekend peak, although great in magnitude, is dispersed among several focal points such as Al-Haram and mosques around the city. The Friday afternoon peak is the largest of the weekend. This is due to Friday prayer, which attracts many people from within the city and outside it. They congregate at Al-Haram and other mosques scattered about the city. The evening peaks of Wednesday and Thursday are both significant due to the habit of going shopping, visiting etc., discussed under the Origin and Destination Purposes section

The external roadside interviews recorded at points north and south of Al-Haram produced data on external trips to the city of Makkah (Table 3.20). The Table indicates that the traffic flow at the station south of Al-Haram is greater than the flow at the station to the north. Jeddah produces the most trips to Makkah, particularly at the weekends. This is because Jeddah is the gateway to the city. Many trips are made for religious purposes due to the proximity of Makkah. Riyadh and Taif are further away and therefore fewer trips are made from these places. Thus, it can be concluded that distance affects the frequency of trips.

3.6.2 The Origin and Destination Purposes

A total of 606 trips was recorded in the survey of roadside interviews (Table 3.21) in Makkah. This analysis includes external trips. The Table shows that a high proportion of journeys were recorded as home-to-home trips and work-to-work trips, the latter in particular indicating trips by commercial and goods vehicles.

Comparing destination purposes, the study revealed that the most significant destination is home and the other important destination purpose is a religious one, which reflects the importance of Al-Haram as the main centroid in attracting journeys inside and from outside the city of Makkah.

Table 3.20 External Traffic Flow to Makkah,1985

Census Point	Total External Flow Recorded	%*
South of Al-Haram	34	5.6
North of Al-Haram	7	1.2
Total	41	6.8

* Calculated from valid interviews in the road side survey.

Source:Fieldwork,Makkah 1985

Table 3.21 Origin and Destination Purposes

Origin	Trips	%	Destination	Trips	%
Home	285	47.1	Home	205	33.9
Social visit	29	4.8	Social visit	55	9.1
Work	60	9.9	Work	31	5.1
Market	66	10.8	Market	66	10.8
Religious	74	12.2	Religious	169	27.9
Pleasure	11	1.8	Pleasure	14	2.3
Health	21	3.5	Health	10	1.7
Others	60	9.9	Others	56	9.1
Total	606	100.0		606	100.0

Source:Fieldwork,Makkah 1985

Table 3.22 Trips by method of travel

Method of Travel	Number of Trips	%
Private car	497	82.0
Taxi	34	5.6
Bus	75	12.4
Total	606	100.0

Source:Fieldwork,Makkah 1985

3.6.3 Mode of Travel

The predominant mode of travel is the private car (Table 3.22). The total number of journeys made by private car is 497 (82%), while taxis account for 34 trips (5.6%) and the public bus for 75 trips (12.4%).

3.7 Conclusions and Recommendations

There is a high rate of car ownership in the city of Makkah and students contribute substantially to this, accounting for 21.5% (Table 3.12). This fact plays a significant role in feeding the traffic volume in the city with 20% of the total volume at morning and afternoon peaks. As discussed previously, public transport is very expensive and does not provide a direct link between home and school or university. If the trend continues the city traffic will have serious congestion problems during the two peak periods mentioned above. Thus, we would make a radical proposal to reduce the use of private cars by students. The first proposal is to introduce private buses, similar to those used for transporting girls, to carry male students to school or college. If this proposal is not accepted, the second is the use of orthodox public transport. A discount fare could be introduced for students, being validated by the use of a special pass on which would be an expiry date and a photograph. If these recommendations were adopted by the public transport authority, buses could contribute to reducing student dependence upon the private car, both in their normal travelling and their journeying to school.

Regarding places which attract trips to work in Makkah, it is noticed that the Ḥaram area is the focal point, attracting 23% of the total trips. This keeps the Ḥaram area busy at all times. The city authorities are trying to reduce the traffic volume around the Haram area and the Central Business District (C.B.D.) by creating the inner circular road to separate automobiles and pedestrians. We would recommend that, in addition, the volume of traffic created by workers and traders crossing the Haram should be taken into consideration. We would propose that mini-buses might be used by employees and traders in their movement between home and work place, thereby reducing the number of cars in the Haram and commercial areas. The number of pedestrians would also be decreased if this suggestion were adopted.

In conclusion, the significant role of the private car should be emphasised, although public transport also plays a role in the movement of Makkah's population. The public transport system will be the subject of Chapter 4 where it will be argued that the transport problem of Makkah cannot be properly solved without an efficient public transport system. A dominant theme in these considerations is the role of Al-Haram and its district in attracting a high volume of traffic to the city centre.

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CHAPTER 4

PUBLIC TRANSPORTATION

4.1 Introduction: Transport Policy Objectives

As seen in Chapter 3, car ownership in Makkah is very high in proportion to its population (599,400). The private car is undoubtedly the dominant means of transportation, used by the majority of city people in their daily movement, as shown in the trip generation analysis (Chapter 3). It can be forecast that if the use of private cars continues to increase, this will lead to acute difficulties, such as serious traffic congestion, environmental problems, pressure on creating new roads to meet demands, and an increase in accidents. There is some uncertainty about future levels of car ownership in the city, because so many variables are involved (population, income, and social habits for example). On the other hand, as discussed in the previous Chapter concerning car ownership, those who do not have cars form less than one third of the city population. This latter group needs another form of transportation to use in its daily movement in order to achieve equal mobility.

Public transport is considered the alternative means of transport for those who cannot afford a car or are unable to drive. This Chapter will be devoted to the study of public transport, and divided into two parts. The first will deal with the period 1970-1978, discussing the role of public transport, its operation, level of services and problems associated with it. The second period, from 1979 up to the present, considers new advances in public transport. Discussion on the new form of public transportation will focus on policy (which will be mentioned in the following section), its formation, the role that it plays in the city of Makkah and the evaluation of its level of services.

Public transport policy in most countries including Saudi Arabia, is formulated as part of the general government policy for the national economy. This is because government needs to play a part in decisions affecting the distribution of funds between the different budgetary sectors. There are three considerations applicable to the resolution of the matter:

(a) whether or not to spend on the transport sector;

(b) whether to spend on public transport or private transport;

(c) the amount of expenditure to be fixed for use of public transport.

The allocation of funds for public transport is dependent upon the expectation of the role that it will play in the national transport strategy. The role which it plays is varied, but it is possible to categorise its objectives into four groups, which have been made by the Saudi transport consultant, Nizar Kurdi. These will be considered in the following sections.

4.2 Public Transport Policy in Makkah

There are very important aspects of the Kingdom of Saudi Arabia which, can significantly affect the public transport policy. These aspects are: firstly, the short time since the public transport company (SAPTCO) was established (1979). Prior to this, the public transport was mainly dependent on private buses and taxi cabs, which were run by individuals. Secondly, the majority of bus passengers are non-Saudis, which reflects the increase of car ownership among Saudis. This is also because a large number of non-Saudis are not given or permitted to obtain a driving licence. Thirdly, the low cost of cars in Saudi Arabia and the social motives encourage Saudis to own private cars. Fourthly, SAPTCO largely depends on foreign labour for its operation, with a high proportion being employed as administrators, drivers and mechanical engineers. This fact is significant in the operation of the company. The importance of land use will be discussed in a later section.

4.2.1 The Effectiveness Objectives

Consultants Nizar Kurdi and Scott Wilson noted that effectiveness involves maximising the number of passengers transported while minimising the use of resources. They classified transport effectiveness into four groups:

i) Land availability affects mode of transportation. The underground railway is very effective, since it requires land only for station entrances and train garages. It continues to operate irrespective of passenger numbers, although with fewer passengers, revenues will obviously be less. Public road transport is also cost effective when there are enough passengers. The private car is generally less efficient in its use of land because of transporting so few people and its requirement for long, wide roads and large parking areas.

Public transport is most effective where it serves densely populated areas or where many activities, centred in one location, attract travellers. Land use is affected by the geography of the area and density of population. In some areas there is no particular pressure on land, but from the public transport viewpoint it is important that developing cities should not be too dependent upon private cars.

The spatial development of Makkah has encouraged citizens to opt for private transport, since isolated areas have grown up at distances from the city centre. For example, Al-Awaly district, east of Al-Haram and Al-Sharaiia, to the north, are at distances of 18km and 22km, respectively, from the city centre. If public transport were to operate between these districts and the centre of Makkah, it would be very expensive, due to the distance and the small number of people being catered for.

ii) Energy consumption by public transport, measured in passengers per km is less than private transport, when enough passengers are carried. The private car is more economical when only a few people travel by public transport.

iii) Public transport needs more labour than private transport to operate and maintain it. Private transport saves time, since, in some instances, the passenger can make the journey in the time it would have taken him to wait for a bus. The difference between the amount of time and labour required to service a private car and a bus is not known.

iv) Buses are cost effective when transporting sufficient passengers. It might be possible to restrict the use of private cars and subsidise public transport in the interests of national economy. In the main, public transport is beneficial to the environment and society [1], although private cars might be more suitable for use in sparsely populated areas.

4.2.2 The Social Objectives

The basic social objective is to create equality of spatial opportunity, especially with regard to access to schools, hospitals and other amenities. Mobility is a highly prized aspect of modern city life. So it can be said that public transport in Makkah is considered the ideal means to enable lower income groups to travel conveniently and cheaply.

4.2.3 The Environmental Objectives

The transport policy in general, and public transport in particular, should contribute effectively towards improving the environment in cities. It should be noted however that most of the present means of transportation are causing damage to the environment [2]. This is a fact, as mentioned by Al-Ajami:

> The means of transport which is composed of buses, lorries and small cars, is considered the origin that causes the air pollution around us, where it forms 85% of the air pollution. As the population number is increasing, that means an increase in the number of vehicles. The last factor contributes considerably to the increase of pollutant levels in street air. The statistics show that vehicles

cause 50% of hydrocarbon and 70% of carbon monoxide which, together with other gases, pass into the air we inhale. It is the increase of these gases which causes certain diseases for city inhabitants, such as eye, respiratory system and nose irritation (3).

In 1982, petrol-engined vehicles in Britain were responsible for 19% of the total nitrogen oxides in the atmosphere, 13% of the hydrocarbons and no less than 87% of the carbon monoxide [(4)]. Unfortunately, we do not have data about all the component gases produced by motor vehicles which contribute to air pollution in Makkah, but fortunately we have field data about one of the most dangerous gases produced by motor vehicles: carbon monoxide, which will be discussed in Chapter 5.

While carbon monoxide emission from buses is relatively high, contributing to atmospheric pollution at street level, since there are fewer buses, their net contribution is presumably less than that of cars. In addition to the environmental aspect, public transport is considered the most appropriate means of solving the problem of the high density city centre areas, where new roads need to be constructed, but where scope is limited due to the concentration of buildings around Al-Haram and to the natural terrain.

4.2.4 The Safety Objectives

In most conditions, public transport is demonstrably safer than private transport; it has been found that the incidence of accidents is higher for 1000 passengers per kilometre using private cars, as opposed to using public transport. Public transport drivers are well trained in safety, possibly more than other drivers. The safety factor is also important in the design of buses (5). The size, height, weight and body efficiency of the public buses are significant in increasing safety. Also, routine repairs and services are legally required for public transport, playing an important role in road safety standards (6).

4.3 Historic Review of Bus Services

Public transport plays a significant part in the city of Makkah. This is because there is a demand for public buses from those who do not own a car or are unable to drive; also from visitors to the city during several months (Rajab, Ṣhaaban, Ramadan and Al-Hajj).

The importance of buses and taxis to Makkah is evident, having no other public transport such as railways or tramcars. It was noted by the consultant, Robert Matthew, in 1975, that people in Makkah depend on public transport, particularly buses, more than any other means and to a greater degree than any other city in Saudi Arabia (7). This was due to the physical setting and topography which have resulted in scattered development. Since Robert Matthew's report, the background has changed somewhat, our survey revealing that the private car is now the most favoured means of transportation in Makkah (see Chapter 3). This reflects the good economic situation which Saudi Arabians enjoy and the development in Makkah after 1975 of a modern road network (see

Chapter 2).

Public transport has operated in Makkah since about 1965 [8] and was originally used only by men, the means favoured by women for all journeys in the city being taxis and private cars. Buses were mainly used by lower income groups and men travelling on their own.

Buses in Makkah were privately owned, but the Traffic Department in Makkah exercised certain controls. This was in order to guarantee that more organisation and better management should be provided [9]. Mini-buses were used in the city, their capacity ranging from 12-21 passengers. The number of mini-buses licensed during 1975 was 80 and they were commissioned to run on ten routes (Fig. 4.1) within Makkah [10].

4.3.1 The Old System of Operation

The system of operating buses before 1978 followed the radial pattern, with its axis mainly in the Al-Haram and nearby areas. Buses stood at two locations; one at Ajiyad district, behind the hospital and 100 metres from Al-Haram, and the other at Al-Shabikah district, 200 metres from Al-Haram. The latter stop catered for passengers travelling to the eastern and northern parts of the city. There were two bus stops on the route, one at Ali Path and the other, 500 metres away at Al-Maala. The Al-Shabikah stop catered for passengers travelling to the southern and western parts of the city. The same routes were used for outward and return journeys.

BUS ROUTES AND STATIONS IN MAKKAH 1975

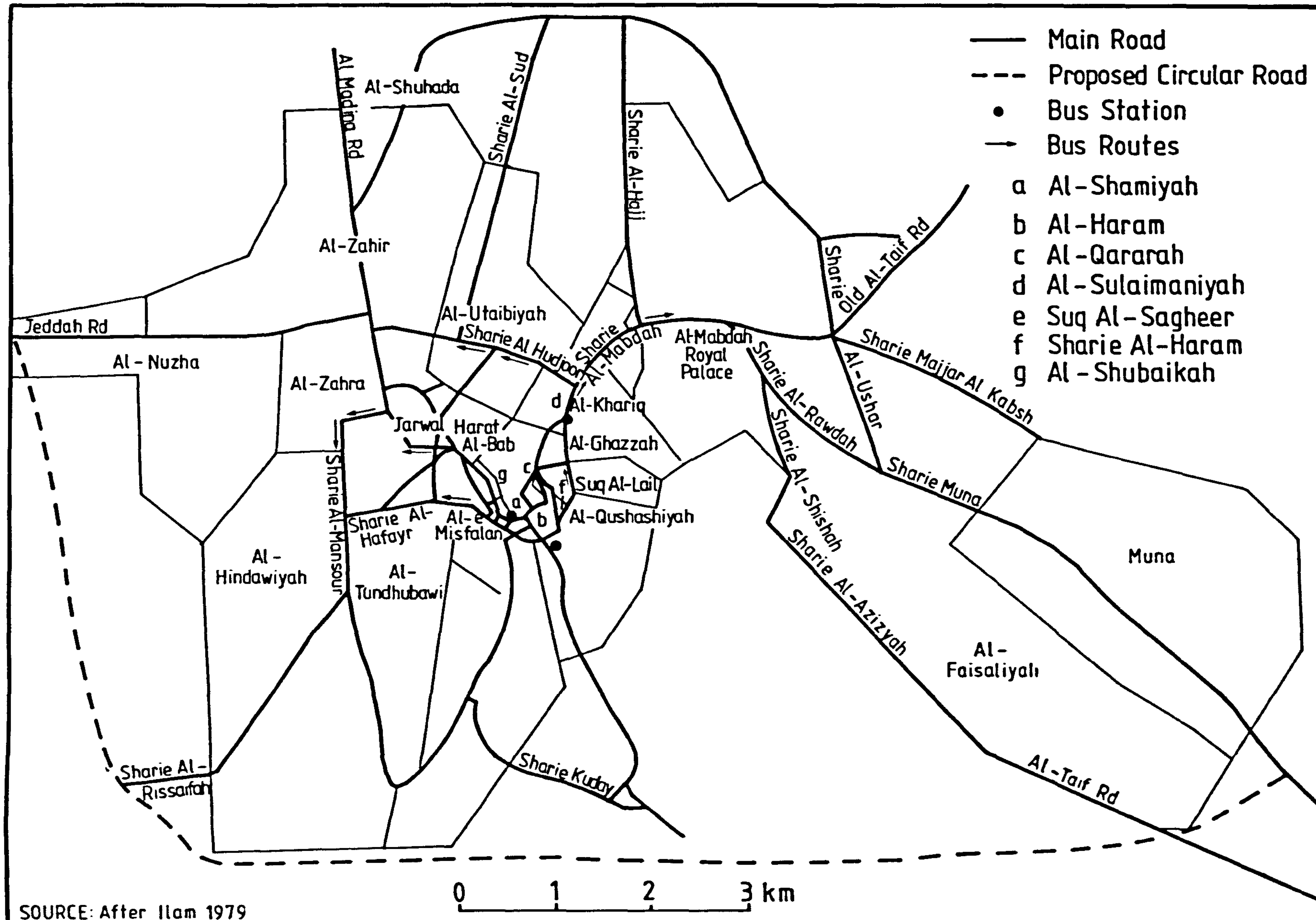

Fig.4.1

The buses usually operated between 06.00 and 21.00. There was no fixed timetable, but there was an increase in services at peak hours which are: 07.00-09.00; 12.00-14.30; and 17.00-20.00.

Bus routes followed the boundaries of the built-up area and ended at the city outskirts. There were no definite bus stops along the route, which depended on the wishes of the passengers to board and alight where they wished. This system had advantages and disadvantages, which will be discussed in another section.

The bus fare cost approximately four Saudi Piasters in 1970, ten Saudi Piasters in 1975 and one Saudi Riyal after 1975. The reason for raising the price three times was to meet the expense of oil and petrol needed to run the buses. The fuel used for mini-buses is benzine, which is more expensive than diesel. The costs of lubricants and services required by the bus also had to be met. The major reason for raising the fare was due to the fact that private buses did not receive any subsidy from the government. Thus, as a result of these considerations, it was necessary to quadruple the ticket price from that of 1970. The bus fares were fixed for all routes and for any distance in one direction.

4.3.2 The Evaluation of the Old System

This section discusses the level of transport services in the period before 1978, its benefits and disadvantages. The discussion will be based upon the personal interviews held in 1985, with the past bus owner and with some of the city people who experienced bus travel before 1978. This was necessary because no written data have been found.

The mini-bus journey time was considered reasonable, overall average speeds varying between approximately 5kmph within central Makkah and over 17kmph in the outer areas [11]. As mentioned previously, waiting time at terminals was dependent upon the availability of buses. Usually, the waiting time was from 15 to 30 minutes.

Journey time was dependent on the number of passengers. At peak times, boarding at main terminals could take over 15 minutes. Thus, fewer passengers meant a journey of shorter duration. In general, the journey time, without calculating time taken to fill the bus at terminals, averaged between 20-35 minutes.

The old system contributed towards congestion on narrow city streets (see Chapter 2). The traffic congestion caused by the mini-buses was due to the continual stopping to pick up and set down passengers, because of the absence of bus stops along the bus routes. The sudden stopping and starting without due regard to other road users was commonly considered to be the reason for most accidents. This reduced the level of safety provided by the mini-bus.

When there were too few passengers waiting, the driver might not stop believing that there might be larger numbers waiting further ahead. Passengers objected and demanded that buses stop, even for only one passenger, regardless of profitablity.

Another common cause of complaint was the practice whereby bus owners sometimes turned back on routes where numbers of passengers were low, thus inconveniencing those waiting further along the route. This treatment led to passengers to seek other means of transportation. One obvious result was the increase in car ownership (see Chapter 3).

The lack of a bus timetable made it difficult for travellers. However in general, the frequent use of the bus gave passengers a rudimentary idea of its likely time of arrival. Overall, waiting for buses resulted in a great waste of time.

The major disadvantage of public transport prior to 1978 was that bus drivers felt no obligation to provide the service continuously. They stopped for up to two hours every day; after 10.00 for breakfast and after 14.30 for dinner and a rest. Additionally, the absence of bus services during several seasons, such as Ramadan and Al-Hajj, caused inconvenience to bus users. Most of the bus drivers who worked on their own preferred to transport visitors to the city between Makkah and Jeddah, and between Al-Haram and the Ummra area outside the city, taking them to visit the holy sites (Mina, Muzdalifah and Arafat), because this was more profitable than carrying regular passengers. Thus, the bus services were generally insufficient to cater for the city people who were completely dependent on public transport.

The absence of the public bus created the opportunity for other types of vehicle to be used to pick up passengers along the bus route. While taxis and private cars were utilised, the main source of transport was the Japanese pick-up (Toyota/Datsun) which could carry between 10 and 12 passengers. The driver of this latter could often be persuaded to deviate from the bus route. Although not as safe as the bus, this was a good substitute. Since the Japanese pick-up is also designed to carry loads, it was not always available to transport passengers.

4.3.3 The Demand for Existing Organised and Sufficient Public Transport

It is apparent from the foregoing discussion that before 1978 public transport services in Makkah were inadequate. This encouraged people to own cars. People on low incomes, however, although served inadequately, still depended on public transport. There was demand for the city authority to provide a well organised and efficient bus service at all times. The new form of public transport now exists in Makkah and also all over the Saudi Kingdom, and this will be the subject of the next section.

4.4 The Formation of SAPTCO (1979)

The government of Saudi Arabia has realised the significant role that public transport plays, by providing good, safe, modern modes of transport, catering for men and women. In 1397 AH (1977AD), His Majesty King Khalied Bin Abdulaziz decreed that a public transport system should be established throughout the Kingdom of Saudi Arabia [12]. As a result, the Saudi Public Transport Company was set up in 1399AH (1979AD) with a capital of SR 1000 million (equal to £194.1 million). The government has a 30% share of the capital and there are 35,000 shareholders [13]. The Saudi Public Transport Company (SAPTCO), a Saudi joint stock company, was formed to operate this system under contract to the Ministry of Communications. Under the terms of this contract, SAPTCO provides both local and intercity public transport services and may receive government subsidies.

SAPTCO began its local service operation in Riyadh in 1399AH (1979AD) and has subsequently established local services in Jeddah, Medinah, Dammam, Taif and Buraydah. Additionally, intercity services have been established between Jeddah, King Abdulaziz International Airport, Makkah, Medinah and Taif in the Western Region and Jubail, Dammam and Hafuf in the Eastern Region of Saudi Arabia. Public response to this new transportation service has been favourable [14].

The local service of SAPTCO was initiated in Makkah on 22nd Dhu Al-Qiddah 1399AH (1 October 1979AD), with the start of Route 1 from Kissma to Rii Baksh (Fig. 4.2). A further 18 routes were later introduced (Fig.4.3) [15]. By 1985, the total number of routes in the city of Makkah had increased to 20 [16].

Fig.4.2 ROUTE NO.1 IN MAKKAH

SOURCE: SAPTCO,Riyadh 1986

Comparing the routes served by mini-buses in the past, it is apparent that the new public bus system is more effective and covers a larger number of routes. At present, SAPTCO is operating 21 routes, most of which converge on Al-Haram (Fig. 4.3) in Makkah. At peak hours, 114 buses are in operation [17]. The company in Makkah owns 152 buses: 122 single deckers, and 30 double-deckers (see Plate 4.1). The single-decker buses have 35 seats for men, and 7 for women screened off at the back for religious reasons. The double-decker buses have 76 seats for men and 17 seats for women, these latter being on the first deck and, again, screened off at the back [18].

4.4.1 The Operating System of SAPTCO

The operating system that SAPTCO follows in Makkah is the radial pattern, whose focus is the Haram area. Two main bus stations exist at the Haram to serve this system: one is located at Bab Ali, east of Al-Haram, and the other near Al-Shabikah district, west of Al-Haram. It can be seen from the foregoing that the company is following the old system, with the exception of the siting of the terminals.

The frequency of the bus services on routes in Makkah today varies from 10-13 minutes and 40 minutes, mainly depending on the length of the route. This system is considered more profitable for bus users. Sometimes the buses cannot keep to schedule due to traffic congestion or diversions resulting from roadworks [19].

Fig.4.3 Public Transport,Makkah,Routes Network[1986]. Source:SAPTCO,Makkah.

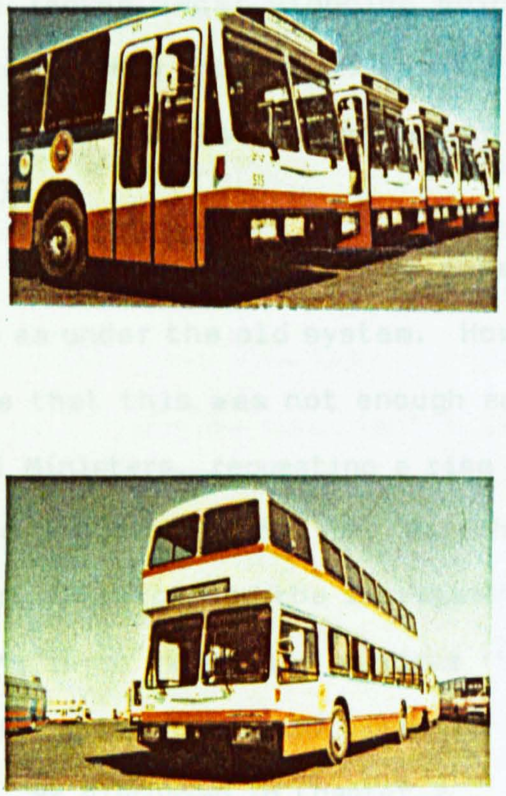

Plate 4.1 Single- and double-decker buses in service with SAPTCO in 1984. Source: SAPTCO, Makkah (1984).

For the first time, the bus services in the city have provided bus stops along all routes in Makkah. The existence of bus stops is convenient for bus users and bus drivers, whereas the old system lacked legal stopping points. The minimum distance between one stop and the next is 200 metres [20]. This stop spacing differs from the average which is 400m to 600m in U.S. cities [21].

Initially, the single fare system remained at one Saudi Riyal, the same as under the old system. However, the company came to realise that this was not enough and reported to the Council of Saudi Ministers, requesting a rise of one Saudi Riyal. This was agreed and since 1983, the fare has been two Saudi Riyals. The company expected the increased fare to add to its revenue, enabling it to extend its services [22]. It is possible that the fare change has decreased passenger numbers, in favour of private cars, as discussed in Chapter 3.

4.4.2 Pattern of Bus Passenger Use

The purpose of this section is to discuss the volume of the services that the company has provided to the city of Makkah since its establishment. The most significant measurements for the public transport company are reflected in actual level of services and number of passengers.

Since the establishment of the public transport company in 1979, Makkah is the second city in Saudi Arabia to have taken advantage of its services.

Over the first four years of operating SAPTCO buses in the city, passengers increased from 10.9 million [23] per year to 28.4 million per year [24]. This reflects the rapid growth of the city (Chapter 1) and the economic boom in Saudi Arabia. However, in the fiscal year of 1403-1404AH (1983-1984AD) the volume of passengers decreased by 24%, compared with the previous year (Table 4.1). The following year saw a decrease of 29% and it was estimated that the decline would continue for 1406AH (1986AD) by about 16%. From the Table it can be seen that the figure for 1986 is approaching that for the first year of SAPTCO operation.

There are three probable reasons for this decline:

1 The sharp increase in private car ownership since the company was established.

2 The sharp decline in foreign labourers in Saudi Arabia who formerly constituted a large proportion of the passengers.

3 Private mini-buses are now allowed to compete along bus routes.

Nevertheless, SAPTCO provides a comprehensive and efficient service in Makkah.

The most heavily used bus routes are 3, 4, 16, 10 and 6 respectively. Bus route 3 has a daily average of 7057 passengers and provides services between Bab Al-Ummra, west of Al-Haram and King Faisal Bridge, north of Al-Haram. Bus route 4 has a daily

Table 4.1 <u>Passenger Volume</u>

Fiscal Year AD	Fiscal Year AH	Number of Passengers	Variation %
1979-1980	1399-1400	10,910,000	-
1980-1981	1400-1401	18,286,000	68% (+)*
1981-1982	1401-1402	23,209,000	27% (+)
1982-1983	1402-1403	28,442,000	23% (+)
1983-1984	1403-1404	21,633,000	24% (-)
1984-1985	1404-1405	15,264,000	29.4% (-)
1985-1986	1405-1406	12,765,936**	16% (-)

Source: SAPTCO Reports (1)

* calculated by the writer

** the number estimated from the passengers of Rabii II where the number was 1,063,828

average of 5900 passengers and provides services between Bab Al-Ummra and Al-Biban, north-west of Al-Haram. Bus route 16 has a daily average of 4270 passengers and provides services between Bab Ali (at Al-Haram area) and the Ummra Mosque, north of Al-Haram. This last is considered one of the most important routes and carries many more people during Ramadan. Bus route 10 has a daily average of 4579 passengers and provides services between

Bab Ali and Umm Al-Qura University at Al-Aziziah district. Bus route 6 has a daily average of 4153 passengers and provides services between Rii Bakhash, south of Al-Haram and Clock Aquare, west of Al-Haram, on Jeddah-Makkah old road. The least used bus routes are 17, 15 and 13 respectively (Table 4.2).

4.4.3 Female Passengers

SAPTCO buses are a suitable mode of transport for conveying women in Saudi Arabian cities. Nowadays, they can benefit from public bus services as well as men. In 1399-1400AH (1979-1980AD) women formed 7.4% of total passenger volume, and in 1400-1401AH (1980-1981AD), 6.8%, giving an approximate average volume of women passengers of 7% per year. This is very low when compared with the United Kingdom, where they constitute 60% [(25)]. It is impossible to predict whether the number of women passengers will increase or decrease. For example, in 1401AH (1981AD) 224,969 women used public transport, while as many as 1,568,119 [(26)] did in 1402AH (1982AD). There are no data for subsequent years.

4.4.4 Passengers by Nationality

SAPTCO noticed that few Saudis in Makkah (as in other cities in the Saudi Kingdom) use the bus in their daily movement [(27)].

Non-Saudis form nearly 93% of passenger volume in Saudi cities, including Makkah [(28)]. This reflects the very low demand for public transport by Saudis, due to their high income which results in increased car ownership (see Chapter 3).

Table 4.2 The Daily Average of Passenger Demand on Bus Routes

Route	Route Name	Annual Passenger Number	Average Per Day
1	Rii Bakhsh -Kisua	571,766	1588
2	Rii Bakhsh-Ummra Mosque	1,251,579	3476
3	Bab Al-Ummra- King Faisal Bridge	2,540,061	7055
4	Bab Al-Ummra-Al-Biban	2,123,835	5899
5	Bab Al-Ummra-Al-Adel	371,592	1032
6	Rii Bakhsh-Clock Square	1,495,158	4153
7	Bab Ali -Clock Square	1,289,628	3582
8	Rii Bakhsh -Al-Adel	299,383	4578
9	Bab Ali -National Hospital	1,281,066	3558
10	Bab Ali -University	1,648,342	4578
11	Bab Al-Ummra -Al-Qashalah	499,556	1387
12	Bab Al-Ummra - Al-Kaki Building	1,402,184	3894
13	Bab Al-Ummra-Al-Jamom	180,278	500
14	Bab Al-Ummra -Mena	309,732	860
15	Bab Al-Ummra -Al-Ummra Mosque	169,224	470
16	Bab Ali - Al-Ummra Mosque	1,537,029	4269
17	King Faisal Bridge - Arafat	25,505	71
Total		16,996,418	47203*

Source:Facts about SAPTCO, Report 1401 A.H. (1981 A.D.)

*Average Figures calculated by Author.

4.4.5 Seasonal Variation in Passenger Demand

No precise data exists about seasonal passenger variation in Makkah, However, in general, there is an increase during Ramadan, Du-Al-Qida and Al-Hajj, because of the visitors and pilgrims coming to Makkah. At these times, extra buses are provided on the busiest bus routes.

4.4.6 The Daily and Hourly Variation in Passenger Demand

No data have been found about the daily and hourly variation in passenger demand. Although this information was sought in the 1985 survey, it was impossible to calculate the number of passengers on all bus routes. From those bus travellers who were interviewed, it is possible to analyse patterns. Buses were in greatest demand on a Wednesday (Table 4.3.1), (last day of the working week), and in least demand on a Friday (being a day of prayer, when people worship at Al-Haram or a nearby mosque).

In the hourly variation of passenger demand (Table 4.3.2), there is a morning peak between 06.00-09.00, while the evening peak falls between 15.00-18.00. There is a less significant peak between 12.00-15.00. The morning peak was created by people catching the bus to work, and the evening peak resulted from workers travelling home.

Table 4.3.1 Daily Variation of Public Transport Passengers in Makkah

Weekdays	Number of Passengers	%
Saturday	79	15.8
Sunday	72	14.4
Monday	72	14.4
Tuesday	55	11.0
Wednesday	111	22.2
Thursday	68	13.6
Friday	44	8.8
Total	501	100.0%

Source:Fieldwork,Makkah 1985

Table 4.3.2 Hourly Variation of Public Transport Passengers in Makkah

Time of Day	Passengers Volume	%
6-9	110	22.0
after 9-12	50	10.0
after 12-15	105	20.9
after 15-18	126	25.1
after 18-22	110	22.1
Total	501	100.0%

Source:Fieldwork,Makkah 1985

4.4.7 External Factors Affecting Public Transport Use

The importance of rising car ownership in Makkah is clear, where household car ownership is the major variable in affecting rate of trips. The private car is the most common form of transport used by the majority of city inhabitants. The private car is therefore considered the major competitor for the public transport company. Car travel has the advantage of being flexible and transports passengers from door to door, while buses have to follow a fixed schedule and route.

Despite the trend of private car competition with the public bus, the bus company has attempted to encourage car owners to travel by bus at some stage during the day [29].

4.4.8 Public Transport Subsidy

> Both private and public transport have major and essential roles to play. For many the car is the first choice. But the streets could not cope if everyone tried to travel by car and many people do not have the option of doing so. It is therefore of deep concern to all who live or work there that the systems for running and financing public transport operate smoothly and effectively (30).
>
> Like other services, the provision of public transport must reflect demand (31).

As previously stated, travel by bus is in decline at present. In many large cities patterns of travel have changed as people and jobs have moved out of the centres [32]. This is applicable to Makkah, particularly since the Haram enlargement.

Public transport is labour-intensive and the cost has been rising sharply. Operators have therefore found it increasingly difficult to meet their cost through fare income and to provide reasonable service levels in the face of falling demand and rising costs .... the gap has been bridged by increasing levels of subsidy (33).

From the foregoing it can be seen that the public transport company faces the same problems that face public transport in the UK. The company has found it difficult to meet its costs through fare income and to provide reasonable service levels in the face of falling demand and rising costs. There must be subsidies to keep prices down, yet provide reasonable service levels.

The Saudi Public Transport Company has an authorised capital stock of SR 1,000 million. Shareholders are assured an annual dividend of 15% on invested capital. The Saudi government has pledged to meet any operational deficit incurred by the system (34).

Saudi public transport receives the government subsidy, which covers the operational loss, shareholders' dividends (more than 35,000 shareholders) and the income tax. The amount of government subsidy varies from year to year, according to points mentioned previously. The purpose of the subsidy is to keep the travelling costs at a low and stable level, but if the government were to reduce the cost of travel, the subsidy would have to be raised to cover net revenues (35).

Table 4.4 shows the amount of subsidy that the company has been receiving from the government. The Table also demonstrates the sharp increase and decrease of the subsidy size. This is due to the amount of subsidy requested from the government (36).

Table 4.4 Amount of Subsidy SAPTCO Received

Fiscal Year	Subsidy (million SR)
1980	292,593,378
1981	35,965,378
1982	880,262,329
1983	1,035,806,017
1984	1,043,602
1985	1,135,870

Source: SAPTCO Reports Nos. 1, 2, 3, 4, 5, and 6
1980, 1981, 1982, 1983, 1984, 1985.

4.5 Taxi Services

People in Makkah without a car who wish to travel between centres in the city make use of taxi services. The taxi serves the individual at the time he wishes and offers door to door service. In Makkah, as in other cities in the Saudi Kingdom, the taxi is deemed suitable to transport a related group (such as a family) to a common destination.

Taxi cabs in Makkah are privately owned and mostly operated by their owners. There are approximately 2,500 taxis in Makkah at the present time [37]. They are mainly Japanese (Toyota/Datsun) made (Plate 4.2). The average capacity is generally four passengers, which is not suitable for a large family. Peak demand for taxis is during weekday morning and evening rush hours and at weekends (Thursdays and Fridays).

4.5.1 The System of Operating Taxis and its Evaluation

There is no single company which organises the running of taxis in Makkah. The system of operation is completely dependent on the taxi owner's interest. Taxis are not available in every part of the city because the experienced driver caters for areas where there is most demand.

The taxi service is adequate around Al-Haram, hospitals, government offices and major markets. Areas away from the city centre are poorly served. Taxis circulate all the time, clearly raising the traffic volume on city streets. In 1976, the taxi flow at the morning peak period represented approximately 11% of the traffic volume [38]. This proportion is high due to the fact that there are no taxi stands and the police do not allow taxis to stop for long on major city streets, therefore they have to keep moving. This not only contributes to congestion, but also to pollution and accidents.

The taxi driver has the freedom to run his taxi at whatever time he wishes. In general, the taxi service can be obtained in the city between 06.30 and 14.30; also between 16.00 and 22.00. The absence of a service after 14.30 is due to the very low demand. People tend to stay indoors during the hottest part of the day (see Chapter 1) and there are only a few cars in the streets at this time. Taxis do not provide a 24 hour service, since a driver cannot work for more than 14 hours.

The tariff of the taxi has increased three times (since about 1970), from SR 2 to SR 5 and from SR 5 to SR 10. The tariff is fixed by the Traffic Department Headquarters. There is no system of taxi meters. The five-fold rise in fares is due to the increase in the price of cars, fuel, lubricants and parts (39). The rise is also to cover vehicle depreciation (40).

In the absence of taxi meters, a few years ago, the driver had the opportunity to ask the fare he considered appropriate. This leads to bargaining which may still result in a price double the fixed tariff. The taxi fare may be raised by the driver at weekends and high seasons, due to increased demand. Bargaining operates as a result of the driver's estimation of distance, time taken and traffic conditions, which affect the fare (41).

A variety of difficulties face the potential taxi user. Cabs are not centrally organised, and it is therefore difficult to order one. Anyone wishing to take a taxi must go to the main streets of the city (sometimes a considerable distance) because taxi drivers do not go to areas where they are unlikely to find passengers (42). The wait for a taxi can be lengthy.

4.5.2 The Demand for Taxi Services

It is apparent from the foregoing discussion that the taxi service in Makkah does not fully meet passenger demand and requires organisation. The deputy for transport affairs made obligatory the installation of meters in all taxis working in the cities of the Saudi Kingdom. This would achieve equality and prevent bargaining over taxi fares. The taxi tariff follows this system:

(i) At the beginning of the trip and before the vehicle moves, the meter will read SR 5, which will remain constant for a distance of two kilometres, then the meter begins to add 70 Halalas for each additional 500 metres.

(ii) During the waiting period, the meter will add 70 Halalas per minute when the car is occupied by a passenger (43).

In the case of an offence, the taxi driver receives a fine ticket on the spot from the city traffic police. In Saudi Arabia during 1986, 806 drivers were given fine tickets for offences connected with the meter system (44).

The deputy for transport affairs realised that privately run taxis did not meet passenger requirements and were often old and poorly maintained. As a result, the Ministry gave permission to a number of Saudi companies to provide limousines to transport passengers arriving at the Kingdom's airports to and from locations within cities. The scheme operated successfully, so the Ministry authorised companies to provide a service between the urban areas and the districts. At the present time, Makkah has 14 companies running urban taxi services (45).

This modern service is characterised by the following:

(i) Use of modern new cars with certain specifications established by the Ministry of Communication;

(ii) Permanent provision of the service 24 hours each day;

(iii) Provision for passenger safety and comfort;

(iv) Compliance with the tariff established by the Ministry.

Besides the limousines (see Plate 4.3) in the cities, there are small cars for hire (see Plate 4.4). This is a recently established service, with specific rules, and daily or hourly rental rates, according to type of car (Table 4.5). These firms are prohibited from operating cars which are more than three years old [(46)].

The tariff of the new taxi is the same as that which had now been adopted by private taxis. In addition, the limousines are submitted to periodic servicing and safety checks. The purpose of allowing the new system of taxis is to make the taxi services adequate in Saudi cities and available at all times [(47)].

The new taxi service is similar to the private one in that drivers tour the streets in search of passengers. It is still not possible to telephone for a taxi, because houses in Makkah are not numbered and since drivers are not Saudi citizens, they are not familiar with the geography [(48)]. The absence of a detailed map compounds the problem of the limousine company and drivers often have to depend on directions from passengers, which can be confusing.

From the foregoing discussion, it can be seen that the need for an adequate taxi service is not completely fulfilled, and therefore reorganisation by city authorities is required.

Plate 4.2 Japanese-made taxis in Makkah (1978).

Source: Ministry of Transportation, Riyadh (1986).

Plate 4.3 Airport-to-city centre transportation operated by the Saudi Limousine Company (1984). Source: Ministry of Transportation, Riyadh (1986).

Plate 4.4 Typical self-drive car hire available in Makkah.
Source: Ministry of Transportation, Riyadh (1986).

Table 4.5 **For-Hire Small Cars Tariff**

Groups of Cars according to their makes	Daily Fare With Driver (S.R.)	Daily Fare Without Driver (S.R.)	Fare per each Kilometer more than 100 Km* (Halala)
Group (A): Hyundai Pony, Honda Civic, Toyota Corona, Toyota Corrolla, Datsun 150Y, Volkswagen, Mazda 323	165	85	25
Group (B): Datsun 180B, Datsun 200L, Honda Accord, Mazda 929L, Toyota Cresida, Peugout 305	200	120	35
Group (C): Buick Century, Buick Skylark, Chevrolet, Chevrolet Malibu, Pontiac Phonex, Toyota Crown, Datsun 280C.	200	140	50
Group (D): Chevrolet Impala, Chevrolet Caprice, Pontiac Catalina, Pontiac Bonneville, Plymouth Vouter, Buick Park Avenue, Chrysler New Yorker, Oldsmobile, Dodge Royal, Cadillac Sedan DeVille, Peugout 505	250	170	50

* Fares tariff was developed on the basis that the daily average distance travelled by the car is 100 Km. Increase in fare given in the last column of the table is to be added per each extra kilometer either with or without a driver.

Source:Ministry of Comminication,Riyadh.

4.6 Evaluation of Public Transport Services

In 1984 a very wide range of interviews were conducted with officials in Makkah. The District Manager of the Public Transport Company was interviewed, in order to obtain data concerning the adequacy of the service provided. If public transport is satisfactory, people will be encouraged to use the bus. Unfortunately, it was not possible to make any such evaluation, since no data were available. If the bus service is good, it might encourage car owners to use it for routine journeys. In the absence of data, we designed a survey in order to discover public opinion of public transport in Makkah.

4.6.1 The Survey Method

Surveys were essential at a large number of points (Table 4.6). This shows the districts selected and the number of samples obtained from each. The number of checking points was 21, which may seem large, but means that more interviews could be undertaken and a more accurate impression gained of problems faced by bus travellers. The busiest areas from which most survey samples were received were 1, 5, 6, 16 and 17. This reflects their significance as destination points. Thus, only small samples came from areas where fewer people alighted on the particular route selected.

Table 4.6 Location Check Points and Number of Samples

District Name	Number of Samples	%
Al-Haram area	125	25.0
Amir Path	1	0.2
Al-Qushashiah	5	1.0
Ajiyad	1	0.2
Al-Missfalah	58	11.6
Al-Tundbawy	48	9.6
Al-Hindawiah	11	2.2
Jarwal	4	0.8
Al-Zahara	1	0.2
Al-Nuzha	4	0.8
Al-Zahir	4	0.8
Al-Utaibiah	6	1.2
Al-Jumizah	1	0.2
Al-Maabdah	11	2.2
Al-Khansa	10	2.0
Al-Aziziah	151	30.1
Al-Rassifiah	38	7.6
Al-Shishah	8	1.6
Al-Rudah	2	0.4
Al-Adel	7	1.4
Jabal Al-Noor	1	0.2
TOTAL	501	100%

Source: Fieldwork, Makkah 1985

The details requested in the survey were: origin of journey, length of time taken to reach bus stop, length of waiting time for the bus, distance between house and bus stop and time of catching the bus, enabling the calculation to be made of time taken to cover the distance between origin and destination. A general evaluation of the bus services was made including the degree to which passengers were satisfied with the public transport system. Reasons for dissatisfaction were also sought. The survey asked if travelling times were reasonable and whether problems were encountered at bus stops/stations. Interviewees provided information concerning trip purposes which were grouped like those of the household survey. Finally, bus users were requested to give their general comments on public transport.

The survey was conducted on weekdays and weekends. The time of conducting the interviews was from 07.00 to 20.00. Interviews took place as passengers alighted at the completion of their journey, so that details and impressions would still be fresh in their minds and therefore information would be accurate.

A supervisor moved between stops to ensure that interviews were conducted correctly, spending under an hour at each location. Several problems were faced at the time of conducting the survey. The hot weather discouraged people from co-operating. Several passengers pleaded a lack of time for answering the survey. Others took survey questionnaires home, but none were returned to the university address. Yet others were co-operative, but left the survey in the middle, without giving any reason. Several passengers spoke neither Arabic nor English (ie. those who spoke an Indian language) which caused communication problems.

In spite of problems already mentioned, we were able to distribute 1,200 samples to bus users. Samples were taken at random and depended on the frequency of buses and the volume of passengers alighting.

When all the samples were received and examined, it was found that 501 were incomplete and 249 were illegible. Thus, the final analysis was based on the valid samples. The analysis system used is simple frequency and crosstabs techniques.

4.6.2 Survey Findings

Results of the survey in 1985 showed that only 3.4% of bus passengers were really satisfied with the services provided by the public transport company. 43.9% felt the service to be adequate. Thus, total percentage of satisfied passengers reached 47.3%, leaving 52.7% dissatisfied. The reasons for dissatisfaction will be discussed in a later section. Next, we will consider the results of the survey analysis.

4.6.2.1 Time Taken to Reach the Bus Stop

The purpose of this section is to focus on the distribution of the bus stops and the evaluation of time taken to reach them, together with the distance an individual could manage to walk from place of origin. Table 4.7 shows the average distance between origin and the bus stop, in relation to time taken to cover the distance. The most time recorded to walk to the bus stop was 5-10 minutes, forming the highest proportion of 70.9%, with distances varying from 100-300 metres. This means that the distribution of bus stops is very fair and mainly within walking distance. When the distance involved was between 300-500 metres, the corresponding walking time was 10-15 minutes. For those walking over 500 metres, the time taken was 15-30 minutes and they formed 3.8% of the total. Thus, bus stops are situated conveniently for the majority.

Table 4.7 Time Taken to Bus Stop/Station Relative to Distance

Distance between Origin and Bus Stop/Station (metres)	Time Taken to Bus Stop/ Station (mins)	Frequency	%
100-300	5-10	355	70.9
more than 300-500	10-15	127	25.3
more than 500-700	15-25	17	3.4
more than 700-900	25-35	1	0.2
more than 1000	25-30	1	0.2
TOTAL		501	100.0

Source: Fieldwork, Makkah, 1985

4.6.2.2 Duration of Waiting Time and Problems Occurring at Bus Stops

The study revealed that the waiting time for the bus in the categories 5-9 minutes and 10-15 minutes constituted 35.4% and 61% respectively. Thus, the most usual length of waiting time was 10-15 minutes (Table 4.8.1). The reasons for such a long waiting time are infrequent services and lack of timetable information (Table 4.8.2). Congested road conditions contribute to the former problem (49). The lack of travel information caused a problem for 27.9%, while 15.4% were concerned about buses not arriving as scheduled. The most significant problem connected with bus stops is the lack of shelter, which was the complaint of 32.7%. The lack of shelter could be an important factor in discouraging people from waiting for buses during the heat of the day (see Chapter 1) and cause them to seek another form of transport, thereby affecting the company's revenue. As a result, a Saudi company was engaged to build shelters at bus stations/stops on routes in Makkah and other Saudi Arabian cities. This action was also taken because of complaints printed in the newspaper.

The shelters were designed to protect passengers from the heat of the sun, at the same time enabling them to see when the bus was coming. The shelters had seats, lighting and timetables. They were also divided into two sections, since men and women had to be kept separate due to religious rules. The shelters were constructed of unbreakable glass (50).

Table4.8.1 Duration of Waiting Time for Bus

Time*	Frequency	%
5- 9	177	35.4
10-15	306	61.0
15+	18	3.6
TOTAL	501	100%

* Time is calculated by minutes

Source: Fieldwork, Makkah 1985

Table4.8.2 Problems Faced by Passengers at the Bus Stop/Station

Type of Problem	Frequency	%
Bus not on time	140	27.9
No shelter	164	32.7
Lack of timetable	77	15.4
All of the above	120	24.0
TOTAL	501	100%

Source: Fieldwork, Makkah 1985

In 1985 and 1986, surveys were conducted to discover how many shelters had been erected. It was found that there were a few sited at places like Al-Haram area and Al-Seteen Street, but nowhere else. The material used did not offer protection from the sun's radiation, but actually concentrated the heat to such a degree that passengers did not use them. No timetables had been provided in the shelters or at bus stops/stations. The lack of information obviously discouraged occasional travellers from using buses. Those who frequently caught buses knew from experience when they were likely to arrive.

4.6.2.3 Length of Journey Time by Bus

The study revealed that the majority (84.6%) considered the time taken between origin and destination when using the public bus to be satisfactory (Table 4.9.1), 4.2% very satisfactory, and the low proportion of 11.2% unsatisfactory. From the 1985 survey it was found that the average length of trip time was 25-35 minutes, which was reasonable (Table 4.9.2), while the shortest length of time was 10-20 minutes. Unfortunately, there are no data concerning distance covered on the trips. Surveys did not ask this question in order to save inconveniencing passengers. Logically, longer travelling times must have related to trips of greater length. In theory, a faster vehicle, like a private car or transit, would decrease travelling time still further, but due to passenger numbers, geography of city streets and distances involved, it would be impractical.

Table 4.9.1 The Degree of Satisfaction with Travelling Time

Travel Time is:	Frequency	%
Very satisfactory	21	4.2
Satisfactory	424	84.6
Not satisfactory	56	11.2
TOTAL	501	100%

Source: Fieldwork, Makkah 1985

Table 4.9.2 Length of Travelling Time

Average Time (mins)	Frequency	%
10-20	50	10.0
25-35	261	52.1
40-50	137	27.4
55+	53	10.5
TOTAL	501	100%

Source: Fieldwork, Makkah 1985

4.6.2.4 Trip Origins and Destination by Districts

The purpose of this section is to distinguish the focal points attracting and generating passengers using the public bus.

Table 4.10 shows that the centres attracting most bus trips and passengers were Al-Haram area and Al-Aziziziah district, with 25% and 30% respectively. The Haram area played a significant role in attracting most bus trips for two reasons:

(a) it is the main junction for most bus trips; and

(b) passengers changing buses have to do so at Al-Haram.

There is no direct route from east to west etc. Al-Aziziziah district attracts many travellers because it has the university, shopping centres, restaurants and private hospitals. Al-Missfalah district attracts 11% of passengers. This proportion is low because it is only about 10 minutes' walk from Al-Haram. Trips are attracted to Al-Tundbawy (9.5%) and Al-Rassifiah (7.8%) because they are commercial areas. The survey revealed that small proportions of people also travelled to other districts, not mentioned in the Table. In some cases, the small sample of replies clearly did not represent the true percentage.

Referring to Table 4.10, the most dominant centres producing (origin) bus trips and passenger flow were Al-Haram area, Al-Missfalah, Al-Maabdah and Al-Aziziah, with 11.6%, 15.7%, 6.4% and 7.8% respectively. It is not surprising to find that those districts played a significant part in generating bus trips, since they were important in attracting trips.

Table4.10 Centres Attracting the Most Bus Trips and Passengers

Destination District / Origin District	1	2	3	4	5	6	7	10	11	26	12	13	15	16	17	19	20	21	22	23	24	25	18	Total	%
1 Al-Haram Step					24	10	4					2		1	2	6	1					1	7	58	11.6
2 Amir Path														1		1					1	1	17	21	4.2
3 Al-Qushashiah									1			1		1	1	2		1	1				16	24	4.8
4 Ajiyad					4	3				1				1									20	29	5.8
5 Al-Missfalah	41				2	23				1						12								79	15.7
6 Al-Tandbawy	13				6	3	1			1						2								26	5.2
7 Al-Hindawiah	3				3	6			1	1	1					6								21	4.2
8 Al-Shabikah	3				14	1	1									4								23	4.6
9 Haret Al-Bab					2																			2	0.4
10 Jarwal	7			1				1		1		1												11	2.3
11 Al-Zahara	1					1	1									1								4	0.8
12 Al-Zahir	5					1	1	3			2					3								15	2.9
13 Al-Utaibiah	2	1	1						2														4	10	1.9
14 Al-Shamiah																1							7	8	1.6
15 Al-Jumizah	2		1											2	1				2				14	22	4.4
16 Al-Maabdah	8														3		2		3				26	42	8.4
17 Al-Khansa																						1	1	2	0.4
18 Al-Aziziah	15		3										1	2			4		2				11	38	7.8
19 Al-Rossifiah	2		1				2			2													11	18	3.6
20 Al-Shishah	3													1	1								4	9	1.8
21 Al-Rudah	1														1								8	10	1.9
22 Al-Adel	3		1											1		1				1			1	8	1.6
23 Jabal Al-Noor																							1	1	0.2
24 Al-Hajj Street			1																					1	0.2
25 Al-Faisaliah	1																						3	4	0.8
26 Al-Kuzha	3																							3	0.6
27 Al-Taneem	12																							12	2.3
Total	125	1	8	1	55	48	10	4	4	7	3	4	1	10	9	39	7	1	8	1	1	3	151	501	100%
%	250	02	16	02	110	95	20	08	08	14	06	08	02	20	18	78	14	02	16	02	02	06	301	100%	

Source:Fieldwork,Makkah,1985.

4.6.2.5 The Purpose of Bus Journeys

The study revealed that 59.8% of trips were made to transport people to their homes. To a lesser extent, the bus service was used to carry people for work or religious purposes; 12.8% and 13.6% respectively. The reason for the low work proportion is the use of private cars which take less time and give the traveller the ability to choose exactly when he wishes to make the journey. Also, as discussed previously in this Chapter, many of the passengers are foreign workers, whose numbers are decreasing at present. No data are available about the percentage of Saudis and non-Saudis travelling to work by bus. This was not included in the 1985 survey for fear of making it too lengthy. The low percentage of bus use for religious purposes is not representative, since a great deal of use is made of it at Hajj, Ramadan etc., for transporting people to Al-Haram. During the nine days of Hajj, the company catered for over a million passengers for religious purposes [51]. The use of public transport for shopping purposes constituted 7.8% which is considered slightly low. This demonstrates that the bus cannot play a similar role to that of the private car or taxi in providing a direct link between shopping areas and home. The bus does not provide enough space for passengers' shopping, unlike the private car, which is most suitable for this purpose. Table 4.11 shows other travelling purposes to be insignificant. The small number catching the bus to school or university reflects the fact that the survey was carried out during the school summer

Table 4.11 Purpose of Using the Public Bus in Makkah (1985)

Purpose of Using the Bus	Frequency	%
Home	300	59.8
Religious	68	13.6
Work	64	12.8
Shopping	39	7.8
Private	10	2.0
Education	8	1.6
To visit a friend	6	1.2
To visit a relative	3	0.6
Personal	2	0.4
To visit a patient	1	0.2
Total	501	100.0

Source:Fieldwork,Makkah 1985

holidays and although it was still term time at the University, many students own cars (see Chapter 3). The only journey for pleasure covered by the survey was that to the coffee house on the outskirts of the city.

4.6.2.6 Problems Facing Bus Users in General

The purpose of this section is to establish all the difficulties faced by bus passengers in Makkah, according to the survey conducted in 1985.

The study revealed 11 reasons for complaint (Table 4.12). Each of these will be discussed in turn and their potential effect on the company examined.

Careless driving by bus drivers is a major cause of dissatisfaction, even though safety is a priority of the company. Carelessness is defined as breaking traffic law, driving over the speed limit, racing other vehicles, stopping and starting too abruptly, each of which can put passengers at risk. Carelessness possibly arises because, 60% of the drivers being non-Saudis [52], some are unfamiliar with traffic law, traditions and environment [53], or cannot speak or read Arabic. For the company to arrange to teach them Arabic would be expensive and would decrease profits. Saudi drivers are careless because of their youthful attitude, often being between 25 and 35 years of age. These drivers can be unreliable and often leave the company, forcing it to employ drivers from overseas.

Table 4.12 Public Bus Users Major Dissatisfactions Makkah (1985)

Dissatifaction	Frequency	%
Careless Driver	26	5.2
Bus not air conditioned	37	7.4
Seats not comfortable	25	5.0
Failure of Bus driver to stop Bus stop	51	10.2
No conductor	37	7.4
Bus not clean	36	7.2
Travel Time is too long	32	6.3
Not well organised	6	1.2
Disorder boarding the bus	6	1.2
Discourteous driver	8	1.6
General	237	47.3
Total	501	100.0%

Source:Fieldwork,Makkah 1985

The buses are not air-conditioned, which discourages people from using them, especially when the sun is at its hottest (see Chapter 1). It becomes very hot waiting for a bus after 12.00 and this problem is compounded when the bus itself is warm. The windows of the bus are not protected against the sun's rays. These factors could encourage passengers who can afford it to abandon bus travel in favour of their own air-conditioned cars.

Bus passengers complained about the uncomfortable seats. These were examined in 1986 and were found to be hard and covered with plastic material which hold the sun's heat. There can be great discomfort due to the perspiration caused by the heat of the seat covering and its non-absorbant nature. It is not known whether this might constitute a health hazard (see Plate 4.5).

Inconvenience is caused to passengers when bus drivers cannot stop at bus stops because of parked cars. This happens particularly on busy city routes, where there are shops, government offices etc. The problem of parked cars at bus stops arises partly because of insufficient parking spaces, and partly because the asphalt is not marked to show that it is an area for buses only. There is simply a bus stop sign (see Fig. 4.4).

There is no conductor on the public bus. Passengers pay their fare into a box situated by the driver. This system is similar to the American one, except that, in the latter case, a machine calculates the correct fare. SAPTCO buses do not have this refinement [54]. Passengers face a problem when they do not

Plate 4.5 Plastic-covered seats in public buses which cause discomfort in the heat.
Source: SAPTCO, Makkah, (1984).

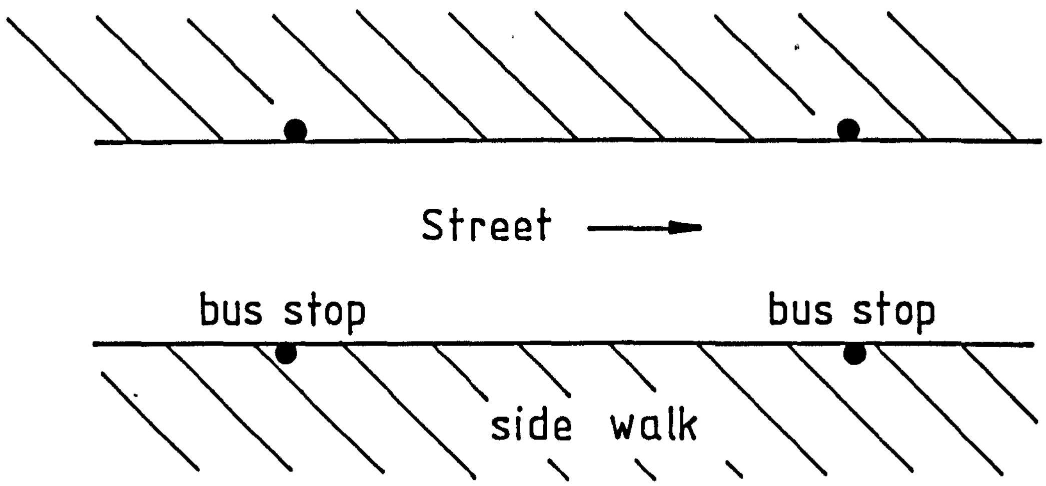

FIG. 4·4 Location of bus stops in Makkah

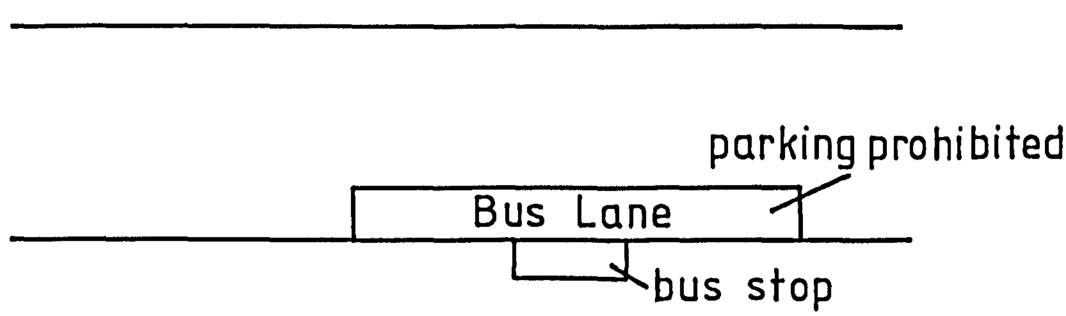

FIG. 4·5 Bus stop bays as used in the U.K.

SOURCE : THE AUTHOR
NOT TO SCALE

have the right change and are sometimes required to leave the bus to find the exact fare, causing great inconvenience and annoyance.

Although buses are cleaned once a day, they are often dirty because of passengers eating nuts and drinking while travelling. It is not feasible for a bus to be cleaned before every journey, but passengers could help themselves over this matter by refraining from eating or drinking.

Bus users complain about overcrowding. Sometimes they have to stand for the whole journey. There are only 35 seats on the bus, which is insufficient to meet the demand at peak times.

The bus passengers also considered travelling time to be too long. Many have to travel great distances which obviously increases the time. However, there are three factors which directly affect travelling time:

(a) frequent stops for passengers to get on and off the bus;

(b) traffic congestion on important routes such as the Al-Haram area; and

(c) in some districts pedestrians cause traffic jams.

This last point will be discussed in the next Chapter.

Problems are created because passengers do not form an orderly queue, and all rush to board the bus when it arrives. This problem is particularly acute at main terminals where large numbers of passengers wait. Another difficulty is that buses do not leave from specific stands in the bus station and therefore it is easy to catch the wrong one or only realise the mistake at the last minute, thereby causing confusion.

Elderly people, in particular, are sometimes treated harshly by bus drivers. This could result in their resorting to a shared taxi or a private car which travels the bus route and where the owner charges the same fare [55]. This was observed during May and July 1986.

4.7 Recommendations and Conclusion

From the foregoing discussion, it is apparent that there are some difficulties facing public transport and its users in Makkah. We will summarise the main points and recommend some improvements for both bus and taxi services, to make them adequate in all ways.

4.7.1 Taxi Services Organisation

From the discussion concerning taxi services in Makkah, it can be seen that they require reorganisation in order to become efficient. The author proposes the following suggestions to improve taxi services in Makkah:

1 At present, it is not possible to telephone to order a taxi, but were the Municipality to number houses and provide detailed maps of each area, the "dial-a-taxi" system could be adopted.

2 The Municipality could also provide a taxi stand at important centres, where demand is heaviest. This would

also prevent taxis from adding to the traffic volume by constantly touring the streets.

3 Taxi stands should certainly be introduced in the Al-Haram area and in important commercial areas.

4 The limousine company should also install short wave radios in their cars to enable drivers to be summoned to wherever they are needed, at any time.

4.7.2 Bus Service Regulation (Management)

As discussed above, most public bus drivers are non-Saudis. It is therefore recommended that the company encourages Saudis to drive buses, since this has many advantages. A Saudi driver speaks the same language as the passenger. Since a Saudi driver has his own accommodation, money spent on housing non-Saudi drivers could be saved. Saudi drivers can be encouraged to work for the bus company by being offered the following incentives:

1 A special premium could be introduced for Saudi drivers who work for the company on a regular basis. This would guarantee free health treatment for the driver and his family [56].

2 The company could allow Saudi drivers to participate as shareholders. This should increase annual income and encourage a more responsible attitude towards work.

3 The company should plan an annual holiday for Saudi drivers and allow them to travel free on company buses, as occurs

with employees of Saudi Airlines.

4 The company should select drivers over 35 years of age in order that they should be experienced, reliable and conscious of passenger safety and well-being.

4.7.2.1 Bus Design

1 Lack of air-conditioning was a passenger complaint. Due to the extra power needed to activate this, the bus company could install air-conditioning in urban buses and utilise it only in the summer, during the hottest part of the day, between 12.00 and 15.00. This improvement would encourage passengers to keep using the buses. A parallel situation is to be found in the USA and UK where, in order to maintain passenger levels, buses are kept warm to counteract the cold conditions.

2 The company should modify the seating design so that passengers can travel in comfort.

4.7.2.2 Bus Stops (Location, Spacing and Design)

The difficulty of being unable to stop at bus stops could be improved if the city Municipality were to adopt a new system of siting bus stops, as recommended by Vukan R. Vuchic (57):

> Near-side (NS), at an intersection before crossing the cross street; far-side (FS), at an intersection past the cross street; and mid-block (MB), away from the intersection. It is common in many cities to adopt one type of stop location (usually NS) and use it throughout the city.

1 We think that the best siting for bus stops in Makkah is MB (mid-block bus bay) (see Plate 4.6), which is useful for reducing disruption of traffic flow, caused by the frequent bus stops.

2 If the street is too narrow for the MB system, because of the complex topography (see Chapter 2), then another can be adopted, as observed in the UK (see Fig. 4.5 above). This is the system of bus bays, where it is prohibited for cars to stop. Any car driver contravening this should have to pay a heavy fine.

3 Shelters should be rebuilt with material suited to weather conditions. Timetables should be provided in them. Despite the cost involved, shelters should be sited at main stops on busy routes.

4 The bus service would be faster and more efficient were the bus stops on Makkah's bus routes spaced further apart [58].

4.7.2.3 Bus Routing, Operation and Organisation

1 On busy bus routes, a separate bus lane would prevent delays, making the journey as fast as possible and keeping buses on schedule.

2 At peak hours, double-decker buses could be utilised to alleviate overcrowding.

3 At the main bus station, buses bound for different locations should be allocated separate areas, appropriately named and numbered. This would prevent confusion amongst passengers.

Plate 4.6 Bus stop bay in Madrid

Source:Vukan R. Vuchic,1981.Urban public transportation system and Technology,Englewood Cliffs,New Jersey.p.274

4 At bus stops, there should be information giving bus number, destination and route taken. Bus users will then be able to check that they are catching the correct bus without having to enquire of anyone.

5 The bus company could alleviate the problem of passengers finding money for change by selling tickets prior to their journeys. Monthly season tickets may be the answer. These would carry an expiry date and a photograph of the traveller. This method would save time and inconvenience.

4.7.2.4 Public Encouragement to Use the Bus

1 In order to make the public aware of the bus services, the company should allow car owners to use public transport free of charge for one week.

2 The media could support the company by encouraging the public to travel by bus, possibly by publicising the effects of pollution, and the safety role played the public bus.

In conclusion, there is no doubt that the private car is still the most popular means of transport among Makkah's people. This is because the private car can be used by the owner as and when desired. It would be difficult to find an alternative to the car.

City planners could attempt to limit the use of private cars at certain times in the day, for example, journeys to and from work and school, thereby reducing congestion on the roads at peak hours. If this were to happen, the bus company would have to improve the service in order to meet passenger requirements. The bus must also be more economic than the car for it to be considered by the car owner as a viable alternative.

Once the public bus has been developed to provide an efficient service, meeting all passenger specifications, then public transport will have an important role to play in Makkah's future, alleviating traffic congestion and reducing pollution.

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CHAPTER 5

ENVIRONMENTAL IMPACT OF MOTOR TRANSPORT

5.1 Introduction

The scale of land distances between Saudi cities, the lack of waterways and restricted rail network lead to a heavy dependence on road capacity. The development of highways in Saudi Arabia has reflected the development of the national economy. Economic prosperity has given the opportunity to the public to possess their own private cars, which has resulted in a rapid increase in number of vehicles in Saudi cities and particularly in the city of Makkah, resulting in the heavy use of roads in the city. The city network serves not only the city people, but also provides services to the city visitors throughout the year when they come to visit Al-Haram to perform Ummra and/or Hajj. This multiple use of the city network served to accentuate transportation problems such as congestion, unpleasant environmental conditions and too many road accidents. These problems will be the subject of this Chapter, in which attempts will be made to recommend improvements.

5.2 Background to Traffic Accidents in Makkah

Road traffic accidents are a major problem world-wide (1). In general, there are three main factors contributing to road accidents: the driver, the vehicle and the environment. A detailed study in 1984 showed that driver errors were wholly or partly responsible for 85% of accidents. Conversely, the environment and vehicle caused relatively few accidents - less than 5% each when acting independently or in combination (2).

Nationally, road accidents in Saudi Arabia are very serious phenomena which require the efforts of different organisations to reduce their incidence. It is also necessary for drivers to be aware of the causes of accidents in order that this serious situation may be rectified (3).

The seriousness of road accidents in Saudi Arabia, is illustrated by Traffic Department statistics which indicate that there were 89 accidents every day in 1986, which is an increase on 1971 when there were about 12 accidents daily (4). On average, an accident occurs every 20 minutes. In the Saudi Kingdom eight people are injured in road traffic accidents every day (5).

The purpose of this Chapter is to ascertain the volume of road accidents in Makkah, based on the official statistical data issued by the General Headquarters of the Traffic Department in Riyadh. These statistics include general data about road accidents. These are: number of accidents, time of accidents (day/evening), weekly variation, monthly variation, condition of the vehicles at the time of the accident, number of fatalities and injuries, age of the driver, educational and marital status of the driver. These data are very useful to run an analysis about the road traffic accidents in Makkah, but only at a general level. This is because no specific data are available which cover the following details:

1 The hourly variation during the day, which is important to ascertain the peak hours when accidents occur and to discover the correlation between time of accident and peaks of traffic volume in the city.

2 The weather conditions, which are also important factors; wet, fog, dust, heat and cold are all influential.

3 The location of accidents in the city, e.g. according to whether or not it is a high density residential area. There is obviously a greater likelihood of accidents where there are more pedestrians and vehicles.

4 "Adverse road design, e.g. unsuitable layout and junction design, or poor visibility due to layout" (6).

5 Adverse condition of road, e.g. poor street lighting and inadequate road signs.

6 "Unexpected obstructions, e.g. road works, parked vehicles, other objects" (7).

7 The condition of vehicles, such as efficiency of brakes, lights, indicators and visibility should be taken into consideration.

In spite of the lack of detailed data, the following analysis of road accidents in Makkah will include information obtained from the General Headquarters of the Traffic Department in Riyadh. Based upon this background, the magnitude of road accidents in Makkah from 1971-1986 and their causes will be studied with the intention of recommending means of prevention.

5.2.1 Road Traffic Accidents in Makkah 1971-1986

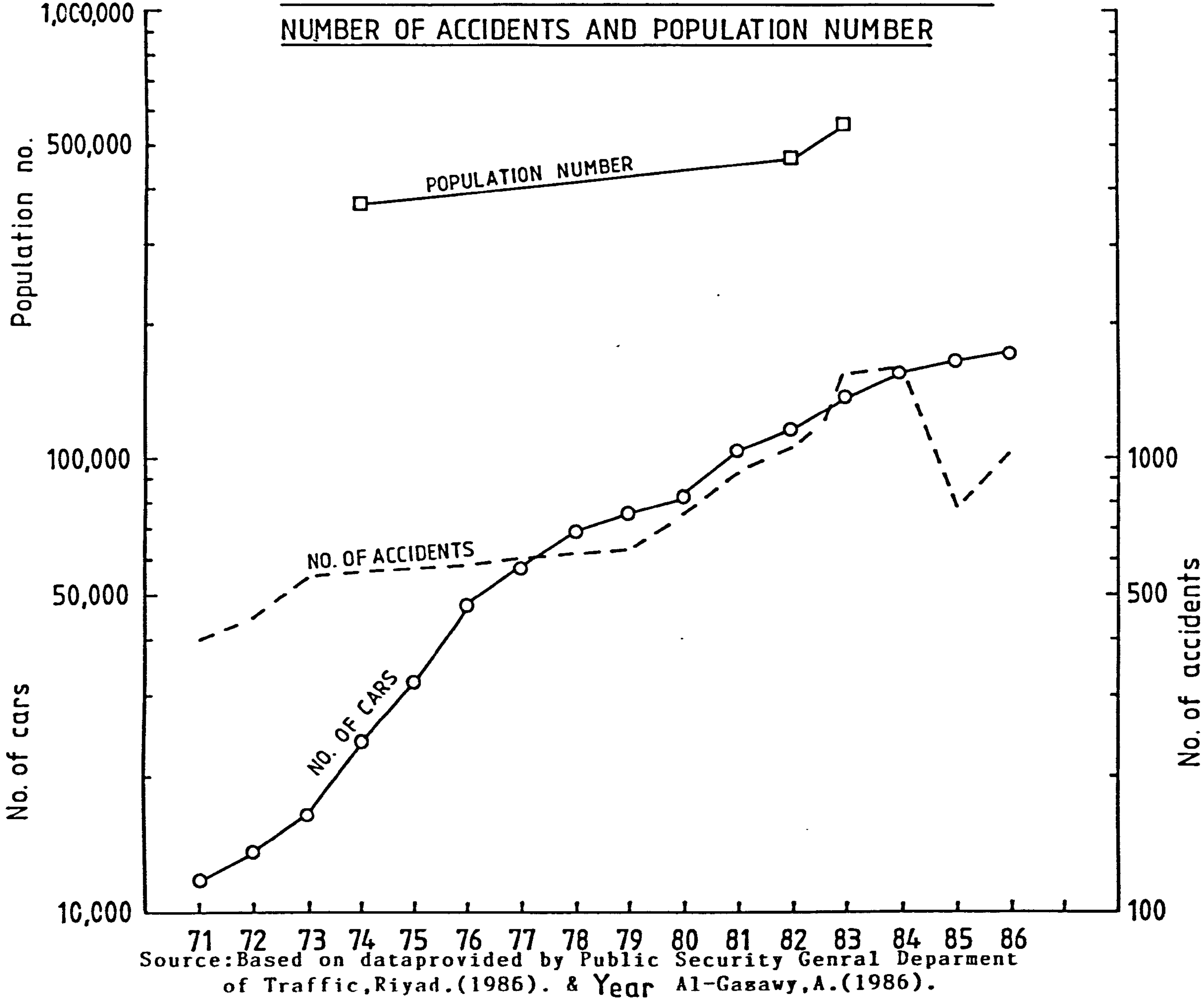
Table 5.1 shows the number of accidents in Makkah. It is evident that the number of accidents has increased between 1971 and 1986, with some considerable increase between 1982 and 1984. This is because the number of cars has increased, particularly during this latter period. The computer analysis showed that there is a positive correlation (0.98) between the number of cars and number of accidents. The more cars, the greater the probability of accidents occurring (see Chapter 3). This is the result of a healthy economy and a growth in population (Fig. 5.1).

The number of injuries due to road traffic accidents has also been increasing since 1971. It is noticed from Table 5.1 that injuries in 1983, 1984 and 1986 were very high. The reason for injury numbers being so high may relate to accidents occurring in busy locations such as a residential area. Moreover, it can be seen from the Table that the number of fatalities also increased. This is a serious situation requiring the concerted efforts of all drivers to reduce the number of accidents in the city. In 1986, on average, two people were killed in road accidents every day.

While the injuries ratio per thousand vehicles is high, it can be seen from Fig. 5.2 that accidents and fatalities have decreased in relation to the increased amount of traffic, that the accident rate is actually decreasing, The decrease of accidents in Makkah in spite of the increase in vehicles relates

Fig.5.1

INCREASE OF ACCIDENTS IN MAKKAH COMPARED WITH NUMBER OF ACCIDENTS AND POPULATION NUMBER



Source:Based on dataprovided by Public Security Genral Deparment of Traffic,Riyad.(1986). & Al-Gasawy,A.(1986).

Table5.1 The Index of Road Traffic Accidents in Makkah

Year	Number of Cars	Number of Accidents	Accidents Per '000 Cars	Injuries No.	Injuries Per '000 Cars	Fatalities No.	Fatalities Per '000 Cars
1971	11900	574	48	839	70	86	7
1972	13588	605	44	880	64	123	9
1973	16501	539	32	790	48	128	8
1974	24047	454	19	684	28	149	6
1975	31660	400	12	478	15	162	5
1976	47113	603	13	691	14	254	5
1977	58754	526	9	861	14	283	4
1978	68957	586	8	634	9	340	5
1979	74797	632	8	1094	14	298	4
1980	81197	736	9	1050	13	276	3
1981	100516	924	9	1334	13	262	2
1982	116509	1566	13	1971	17	341	3
1983	138613*	1551	11	2281	16	347	2
1984	152243*	1566	10	7514	49	1047	6
1985	162409*	790	5	1559	9	198	1
1986	167787*	1048	6	5993	35	648	3

Source 1) Ministry of Interior - Public Security, General Department of Traffic, Traffic Statistics During 11 Years (1971-1981), Kingdom of Saudi Arabia pp77-97

2) Ministry of Interior - Public Security, General Department of Traffic, Traffic Statistics (1982), Kingdom of Saudi Arabia p14

3) Traffic Statistics (1983) p4

4) Traffic Statistics (1984) p.16

5) Traffic Statistics (1985) p.12

6) Traffic Statistics (1986) p.29

* Estimation (8)

to the gradual improvement of roads, greater adherence to the law and good propaganda such as a "traffic week" organised by the Traffic Department designed to draw the attention of drivers to the causes of accidents [8].

It has been mentioned above that the car driver is a factor contributing to the occurence of accidents. Several factors which relate to the driver (age, social and educational status and nationality) are discussed below.

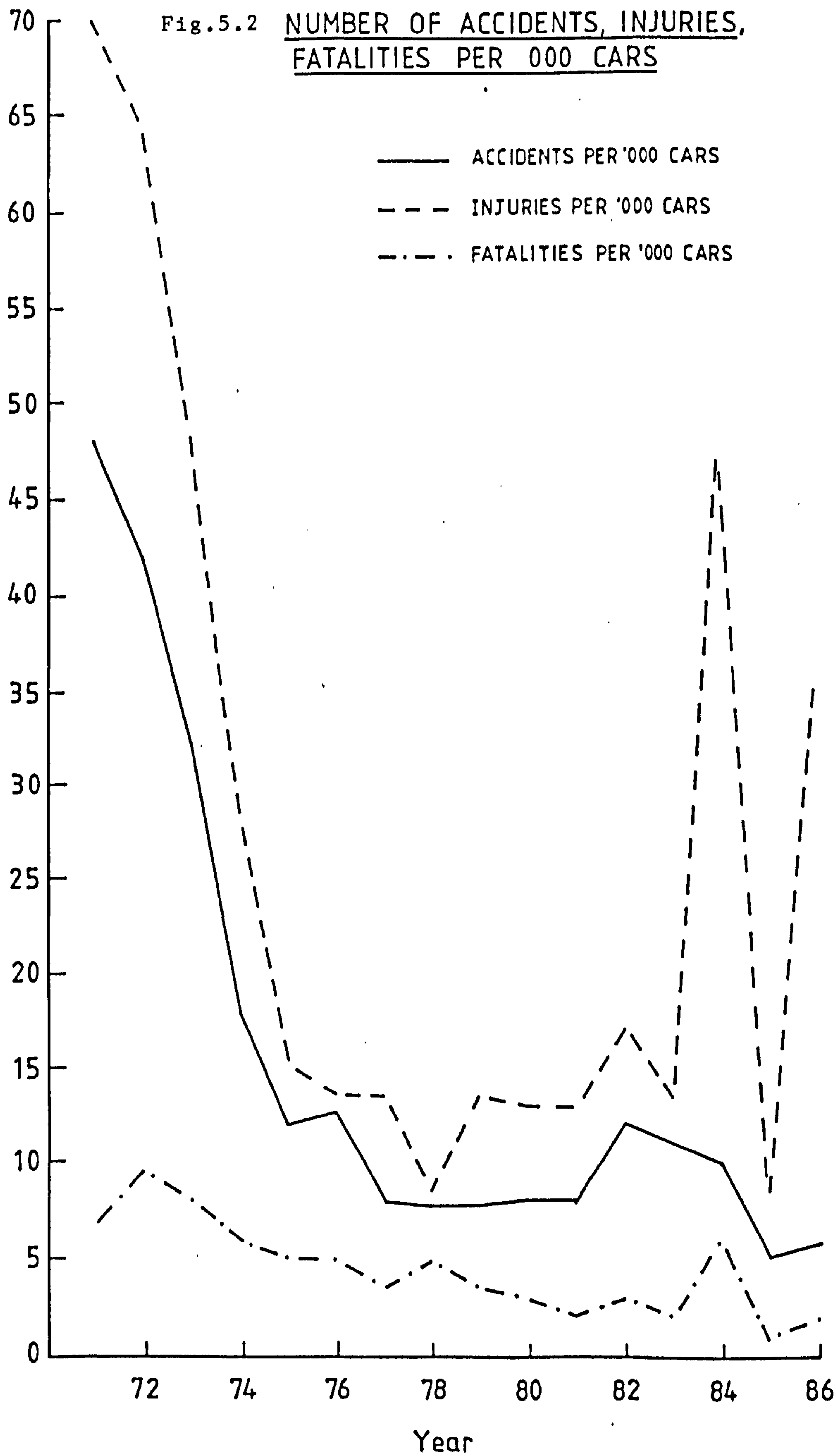
5.2.2 Road Accidents Relative to Age of Driver

The age of the driver plays a significant role in road traffic accidents. Drivers between the ages of 18 and 30 (Fig. 5.3) account for the high proportion of 73.8% of accidents. This in part reflects the high car ownership among this age group (see Chapter 3), and, as explained by some researchers, to lack of experience in some cases and their willingness to take risks [9]. Computer analysis reveals a positive correlation (0.97) between accident numbers and the age of drivers.

5.2.3 Road Traffic Accidents by Nationality

Fig. 5.4 shows that accidents among Saudis are higher than among non-Saudis, with 58.5%, which reflects high car ownership among Saudis. The proportion of accidents among non-Saudis (41.5%) is high in relation to car ownership (35.1%). This high figure may reflect poor driving and ignorance of the traffic

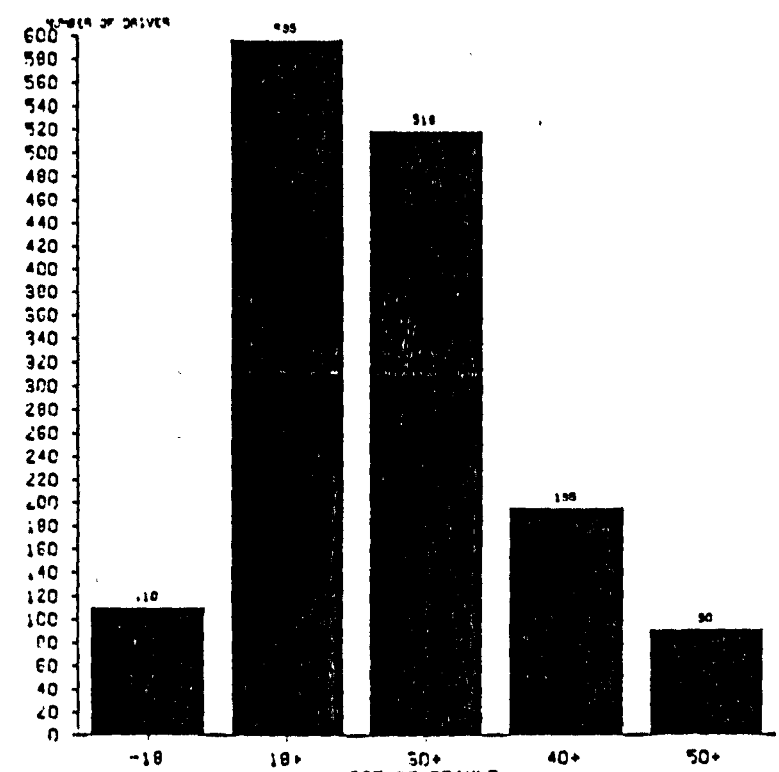
Fig.5.2 NUMBER OF ACCIDENTS, INJURIES, FATALITIES PER 000 CARS



Source: Based on data provided by Public Security General Department of Traffic, Riyadh. (1986).

Fig.5.3

DRIVER INVOLVED IN TRAFFIC ACCIDENTS IN MAKKAH ACCORDING TO AGE



Source:Based on data provided by Public Security General Departmentof Traffic,Riyadh,Saudi Arabia.(1986).

law. Furthermore, non-Saudis can buy second-hand cars which are not roadworthy and contribute to causing accidents.

5.2.4 Road Traffic Accidents Relative to Marital and Educational Status

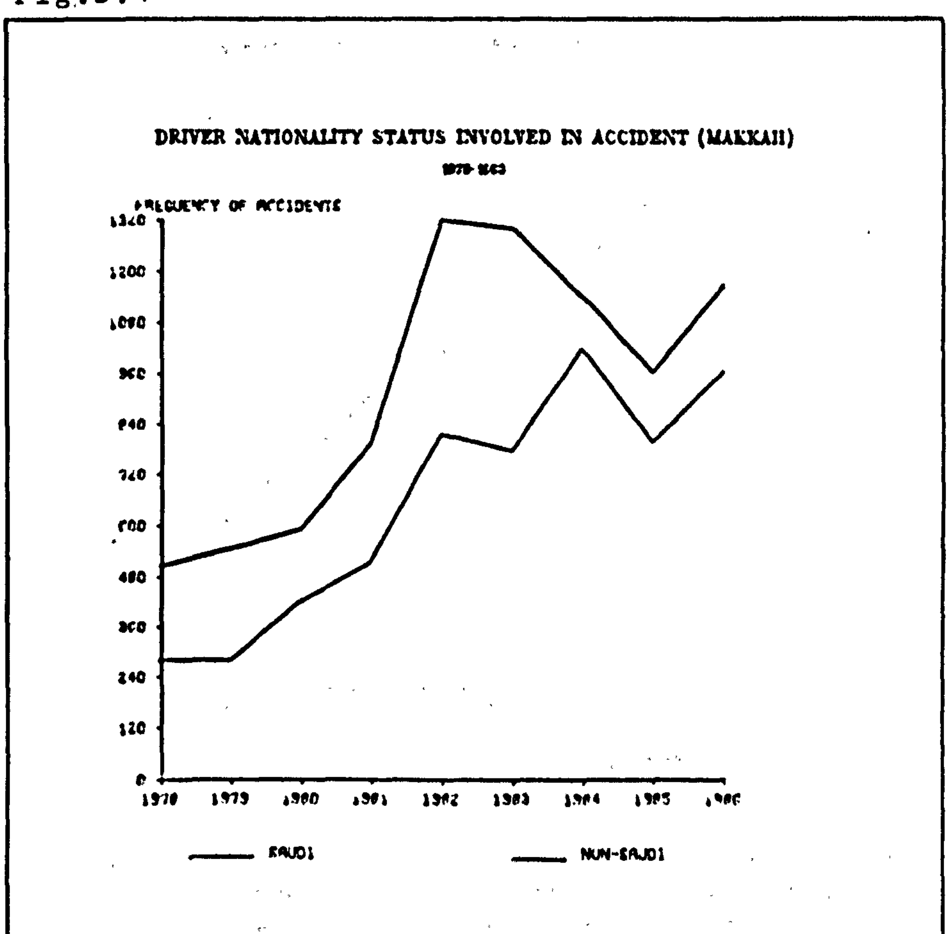
Fig. 5.5 shows that accidents among married drivers are slightly higher than in the case of unmarried drivers, being 51% as against 49%. This reflects the high level of car ownership among married drivers, whereas, as we found from the socio-economic survey results, unmarried males form 16.6% (see Chapter 3). This has serious implications, since many families may lose their breadwinner through death or disablement.

Fig. 5.6 shows that educated drivers involved in road traffic accidents are proportionately very high, constituting 75% of all accidents since 1971; the remainder being made up of uneducated drivers, because numbers of educated people (comprising students, employees with high educational qualifications, and those who can read and write) is high, associated with a high rate of car ownership (see Chapter 3).

5.3 Road Traffic Accidents According to Type

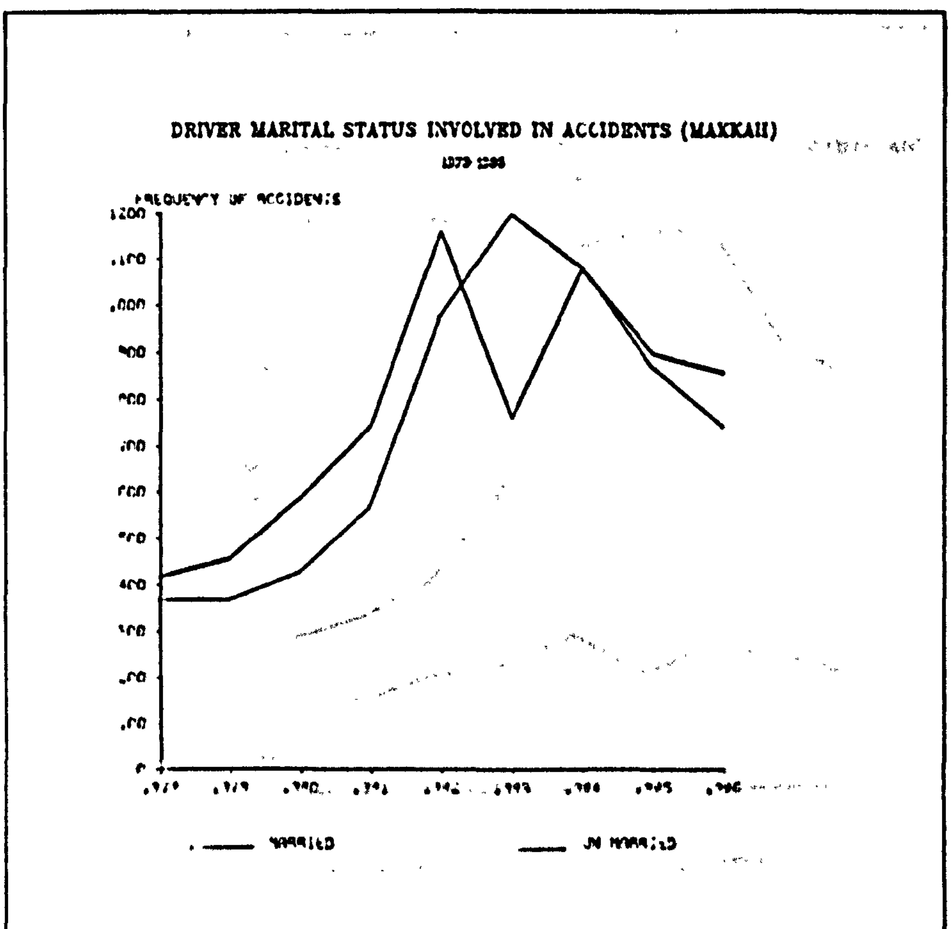
Table 5.2 illustrates the type of accidents which leads to serious injuries and fatalities. The most frequent cause of road accidents since 1971 has been collision between vehicles (35.5%).

Fig.5.4



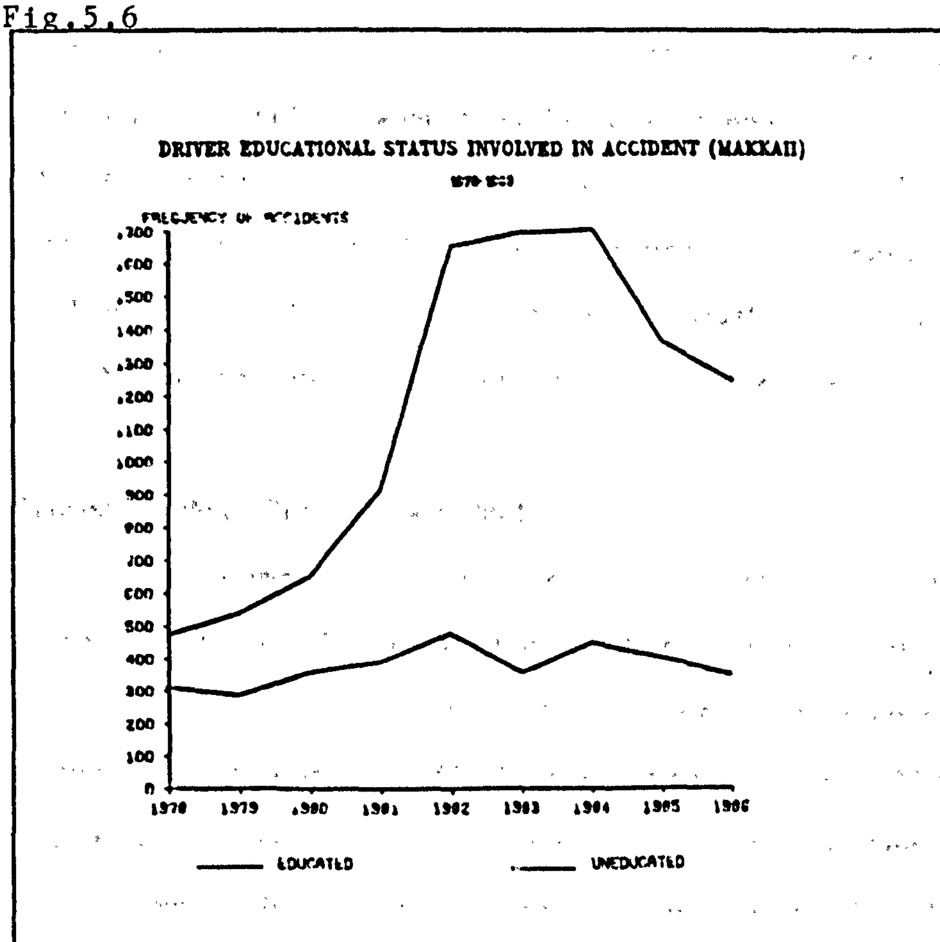
Source:Based on data provided by Public Security
General Department of Traffic,Riyadh,Saudi
Arabia.(1986).

Fig.5.5



Source: Based on data provided By PublicSecurity
General Department of Traffic, Riyadh,
Saudi Arabia. (1986).

Fig.5.6



Source: Based on data provided by Public Security General Department of Traffic, Riyadh, Saudi Arabia. (1986).

This often results from lack of judgement concerning the distance between cars (10). A large proportion of accidents in the city (38% of total) involves pedestrians. Both driver and pedestrian may share the responsibility; the former through driving too fast and the latter through inattention when crossing the road. This type of accident tends to occur in busy areas where there are no zebra crossings. Children playing in the streets on bicycles can cause accidents (11). Parents cannot be wholly blamed because the children often have nowhere else to play.

Overturned cars account for 19% of accidents, possibly due to a blow out or puncture when travelling at speed.

It is obvious from the discussion above that 92.5% of accidents fall into one of three categories. To reduce or prevent these accidents, practical solutions must be found. The causes of these accidents are discussed in the next section.

5.4 Causes of Road Traffic Accidents

One of the commonest causes of road traffic accidents registered by the Traffic Department is high speed. There is a positive correlation (0.94) between the number of accidents and those involving high speed, 38.6% of accidents since 1971 have been caused as a result of speed (Table 5.3). Driving too fast indicates irresponsibility on the part of the driver (12). It is therefore vital that drivers keep to the speed limit. Length of stopping distance increases with speed (Table 5.4) (13), so

Table5.2 Type of Accidents in Makkah 1974-1986

Year	Vehicles	Other	Animal	Human	Fire	Run Down	Leave Road	Other	Total
1974	125	-	-	223	-	67	-	39	454
1975	131	-	-	143	-	94	-	32	420
1976	314	-	-	89	-	182	-	18	603
1977	158	-	-	218	-	158	-	28	562
1978	171	16	3	243	-	126	5	22	586
1979	193	18	4	234	2	166	5	10	632
1980	248	27	4	236	-	171	6	44	742
1981	283	36	4	436	3	142	3	17	924
1982	509	59	9	662	-	268	11	26	1544
1983	458	-	-	608	-	284	-	-	1350
1984	579	61	6	557	4	244	6	44	1501
1985	486	40	6	389	-	201	-	19	1141
1986	599	93	12	547	5	203	12	28	1499
Total	4254	350	48	4585	14	2306	48	327	11958
%	35.5	2.9	0.4	38.0	0.1	19.0	0.4	2.7	

Source 1) Ministry of Interior - Public Security, General Department of Traffic, Traffic Statistics During 11 Years (1971-1981), Kingdom of Saudi Arabia pp217-224

2) Traffic Statistics (1982) p.29
3) Traffic Statistics (1983) p12
4) Traffic Statistics (1984) p30
5) Traffic Statistics (1985) p13
6) Traffic Statistics (1986) p.30

drivers must be able to control their cars and travel at a safe speed. Since 1971, 19.3% of accidents have been caused by drivers failing to stop when traffic lights are red. Overtaking illegally or as a result of misjudgement has caused 9.5% of accidents since 1971 (14). Accidents also occur when drivers fail to check in their rear view mirror or give inappropriate signals before turning off a road, being unaware of what other road users are doing (15). Sudden stopping without due attention to other traffic results in 2.3% of accidents, while the combination of drugs (possibly medicinal) with alcohol or independently, contributes to a further 1.3%. This proportion is very low when compared with Britain. The casualty report in relation to the latter states:

> The number of casualties in accidents in which one or more of the involved drivers subsequently failed the breath test in 1985 was 19,285 (16).

It can be concluded that the driver is responsible for the majority of road accidents, since it is in his power to control the speed at which he travels and to observe the traffic regulations.

5.5 Geographical and Temporal Incidence of Accidents

The purpose of this section is to discover the distribution of road accidents in Makkah according to location and time. The discussion of these elements will be based on the official data issued by the General Traffic Department. The data represents

Table5.3 Causes of Road Accidents

* represent the regions of Makkah

Year	Improper stop	Improper circulation	Improper overtaking	Traffic violation	High speed	Alcohol/ Drugs	Other	Total
1974	-	-	-	6	94	24	330	454
1975	-	-	-	32	134	12	222	400
1976	-	-	-	47	356	-	220	603
1977	-	-	-	32	312	22	275	641
1978	-	18	32	25	378	15	213	679
1979	2	7	66	54	371	13	316	829
1980	64	39	44	72	512	16	245	992
1981	32	68	129	99	438	25	368	1159
1982	147	264	332	270	590	19	369	1991
1983	80	100	200	100	450	30	950	1910
1984*	165*	455	1095	2901	3049	83	1676	9424
1985*	22	60	156	425	687	11	250	1611
1986*	121	200	465	1049	2906	65	1082	5888
Total	633	1211	2519	5112	10277	335	6495	26581
%	2.3	4.5	9.5	19.3	38.6	1.3	24.5	

Source:see Table 5.2

Table5.4 The Necessary Stopping Distance for Each Speed

Speed (Km)	Distance for reaction (m)	Distance for stopping (m)	Overall distance required (m)
30	7	8	15
45	10	15	25
60	15	25	40
75	20	40	60
100	25	100	125
120	30	135	165

The above distances are only applicable on asphalted highways and dry roads.

Source: Ministry of Interior, Public Security, General Traffic Directorate, A Driver's Guide to Motor Vehicle Laws and Operation p19 only a general background for both location and time of accidents. Two broad classifications differentiate location and time of accidents according to the General Traffic Department:

1 Location:

a "in-city" - the urban area, within the city boundary;

b "out-city", - the rural area, beyond city boundaries.

2 Time: daylight; and night time.

Neither of these categorisations is sufficiently specific to allow detailed analysis. For example, information should be given concerning width of road, exact location (residential area, one-way street etc) and time (rush hour etc). Given appropriate data, it would be possible to establish positive or negative correlations between location and time, leading to the possibility of a recommendation for reducing accidents.

Fig. 5.7 shows that road accidents "in-city" (62%) are higher than accidents occurring "out-city". This is because the city has a continuous flow of traffic, with peaks between 07.00-09.00; 13.00-15.00 and 18.00-21.00. Pedestrians are constantly present, increasing the possibility of accidents. Since 1976, the road accidents "out-city" have formed a lower proportion. This may relate to lower traffic volume and lack of pedestrians. Moreover, as C.A. O'Flaherty states:

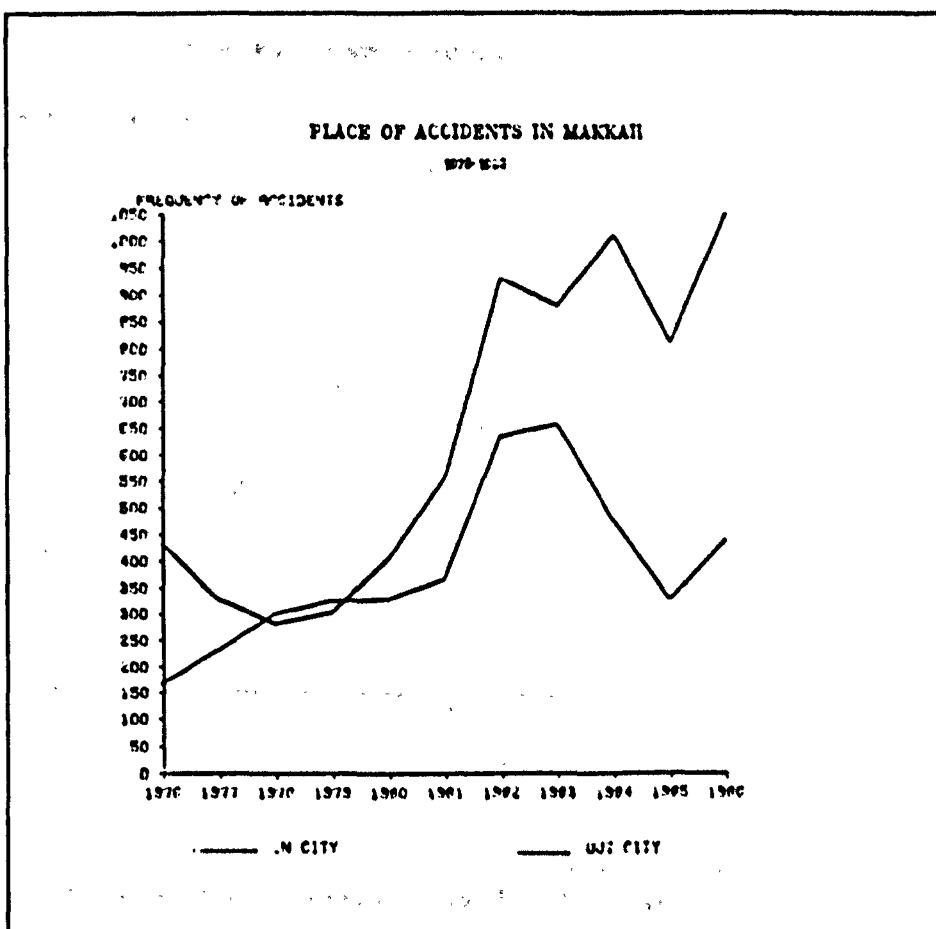
> ... a motorist is much more likely to be involved in an accident when travelling on town streets than on rural roads. This can be attributed mainly to the greater numbers of diversions and decisions to which the urban driver is subjected, eg. at junctions and/or due to the presence of pedestrians and cyclists (17).

Fig. 5.8 shows the time of road traffic accidents. Since 1974, accidents occurring in daylight have accounted for 64.3%, reflecting the fact many more people use the roads during the daytime (to travel to and from work etc). Night time accidents could be the result of poor street lighting or inadequate headlights, leading to poor visibility.

Fig. 5.9 indicates the daily variation of road accidents in Makkah. It can be seen from the figure that the daily average number of accidents from Saturday to Tuesday are similar, and that the daily average for Wednesday is higher. Wednesday evening is the beginning of the weekend when people often travel to shop or for pleasure, as they do on Thursdays, and make visits to Al-Haram. This latter is the focus for many visitors to the city on Fridays, particularly at the time of prayer.

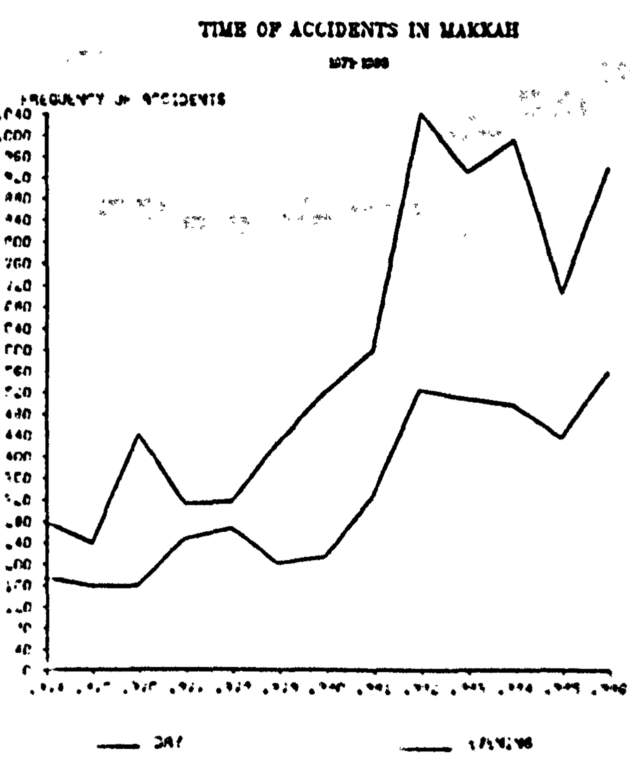
Fig. 5.10 shows the average seasonal variation of road accidents in Makkah from 1976-1986. The greatest incidence occurs during Ramadan and Hajj. These two months are significant because of religious festivals (Ummra in Ramadan and Al-Hajj in Hajj). Also, there are visits to Al-Haram and making Tawaf (going round Al-Kaaba). During the remaining months of the year, there are fewer accidents, indicating that they occur more frequently in relation to increased volume of traffic.

Fig.5.7



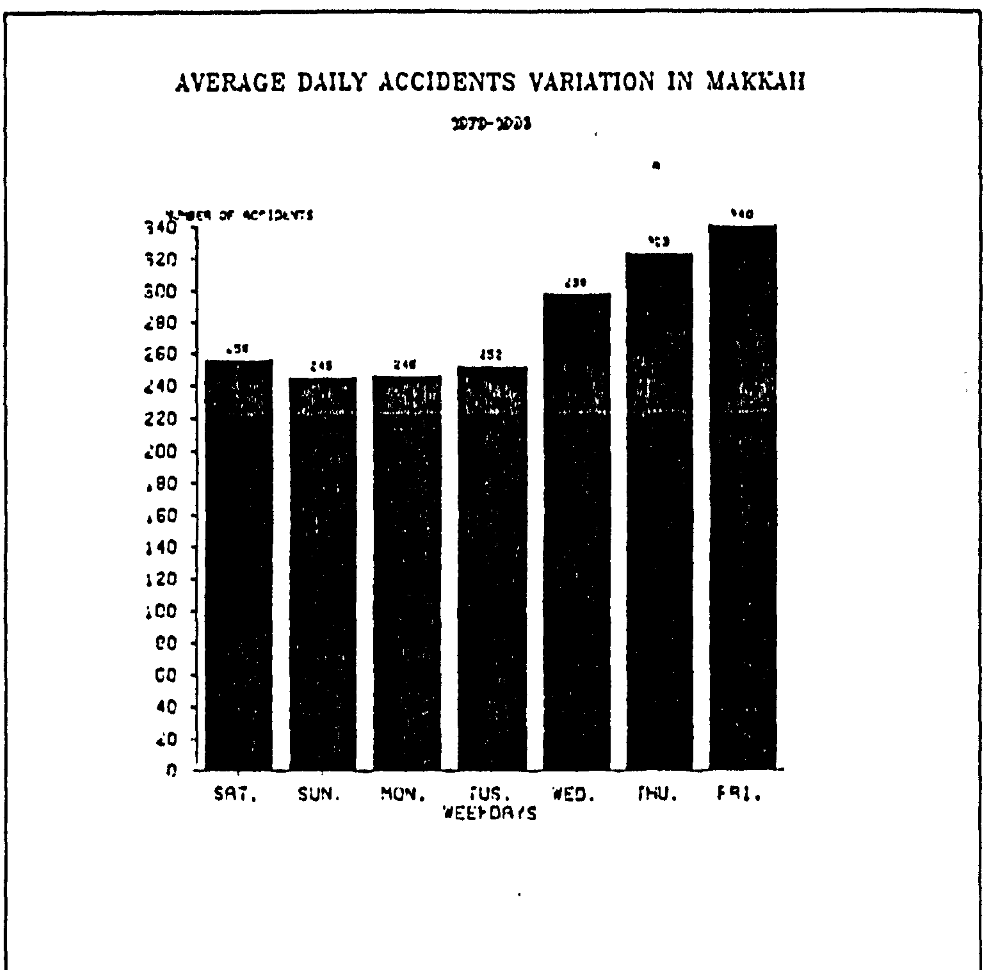
Source:Based on data provided byPublic Security General Department of Traffic,Riyadh,Saudi Arabia.(1986).

Fig.5.8



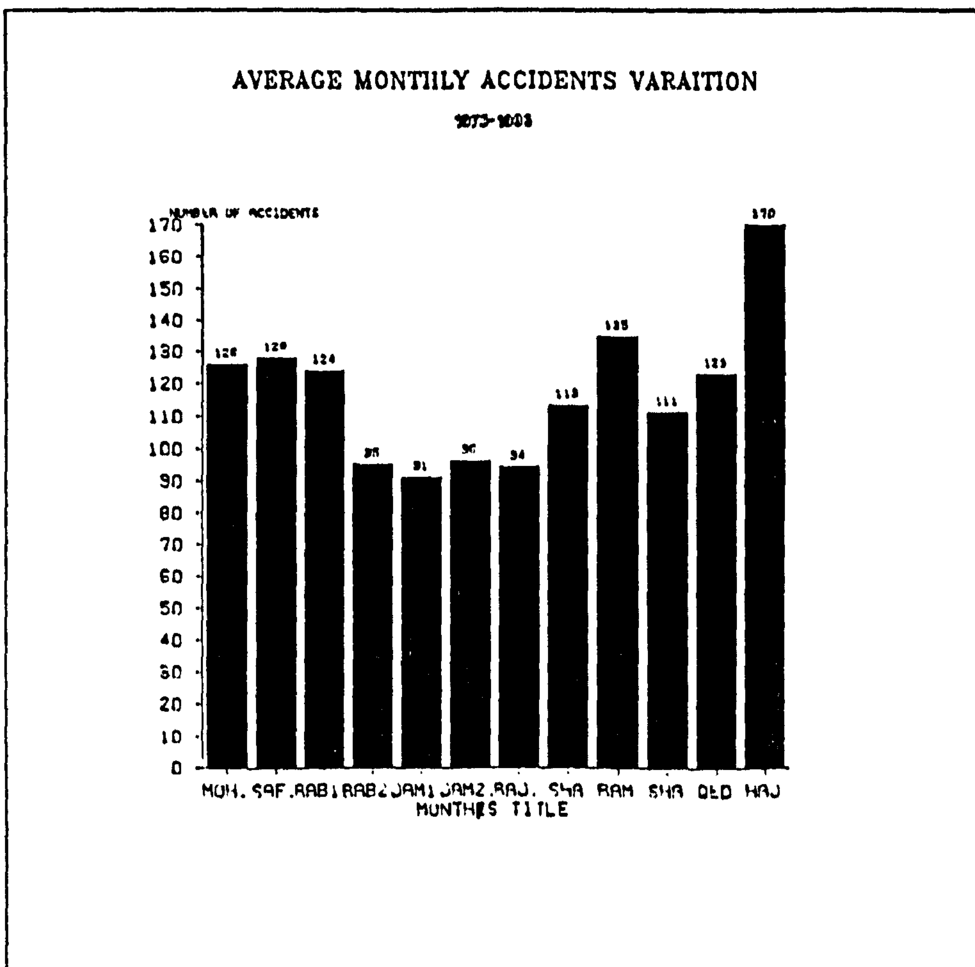
Source:Based on data provided by Public Security General Department of Traffic,Riyadh,Saudi Arabia.(1986).

Fig.5.9



Source:Based on data provided by Public SEcurity General Department of Traffic,Riyadh,Saudi Arabia.(1986).

Fig.5.10



Source: Based on data provide by
Public Security General
Department of Traffic,
Riyadh, Saudi Arabia, (1986).

5.6 Accident: Conclusion

In conclusion, it is obvious from the discussion that road traffic accidents in Makkah are still high as regards injuries and fatalities. Moreover, it is evident that drivers are responsible for most accidents, although pedestrians also contribute towards them. The city municipality also shares some responsibility for road traffic accidents. For example, the planning of the city should include open spaces for children, thereby keeping them away from the roads. Thus, a combination of solutions is required to reduce traffic accidents in Makkah.

5.7 Traffic Volume and Patterns

This section concerns the traffic surveys carried out by the Hajj Research Centre for the city of Makkah. The traffic surveys contained results including vehicle classification counts, traffic counts and vehicle occupancy studies. A series of vehicle classification counts was conducted for both the regional and urban roads of Makkah. For regional roads, various points were selected to conduct the survey, such as on the Jeddah/Makkah Expressway, on the old Jeddah/Makkah road, on the Medina road and on the As-Sail Expressway. Surveys were also conducted on Makkah/Alieth road and Makkah/Al-Taif (via Kara) road. For the urban roads, a number of stations were selected at various points on the city network. A machine was used for counting traffic in each direction on urban and rural roads. During fieldwork in 1985, we surveyed a road selected by the Hajj Research Centre for traffic counting. The object of this survey was to ascertain the number of lanes on these roads and whether they carried a one- or two-way system, and also to establish on which side of urban roads cars were parked, theoretically reducing road capacity.

On regional roads, it is noticed from Table 5.5 that the highest 24 hour volume was on the Jeddah/Makkah Expressway where the volume was 20,201 vehicles. The next most heavily used regional road was the old Jeddah/Makkah road where the vehicle count was 10,404. This traffic volume reflects the patterns of travel on the regional road outside the city of Makkah and demonstrates the link between Jeddah and Makkah (see Fig. 5.11). Visitors to Makkah often arrive at the international airport of Jeddah. Traffic is heaviest during Hajj. Supplies of food etc. for Makkah come via the port of Jeddah. Trips are also made between Makkah and Jeddah for work purposes (see Chapter 3). People are attracted to the well developed beach facilities at Jeddah, particularly at weekends. It is therefore not surprising that the volume of traffic on these two regional roads is very high. Al-Madina is a place of importance and there is a great deal of traffic between it and Makkah (Table 5.5), along the Al-Madina road. Visitors to Makkah often travel to Al-Madina to visit the mosque and tomb of Mohammed, which have great religious significance for Muslims. Two roads, one to the north and one to the east, link Makkah with Al-Taif. Inhabitants of Al-Taif and cities to the south travel to Makkah to perform Ummra and visit

Table5.5 Characteristics Of Regional Roads Makkah 1983.

Station No.	Road Name	No. Of Lanes In Each Direction	Road Classification	Peak Hour Volume By Direction	24 Hour Volume A - B	24 Hour Volume B - A	Two - Way 24 Hour Volume	Hourly Capacity	Peak Hr. V/C Ratio
1	Madina Road (main)	3	Express way	416	4405	4399	8804	3150	0.13
2	Makkah/Jeddah Old Road	2	Primary	481	4641	5763	10404	2100	0.22
4	Al-Leith Road	1	Primary	146	1807	1521	3328	1[illegible]50	0.14
6	Taif As-Sail Road	3	Express way	541	5236	5717	10953	6[illegible]00	0.09
8	As-Sail Road (Al-Sharaiia)	3	Express way	136	2162	2115	4277	[illegible]50	0.03
271	Makkah/Jeddah Express way (main)	4	Express way	858	9137	11064	20201	[illegible]0	0.11
276	Makkah/Al-Hada/Taif Road	3	Express way	2[illegible]4	4034	3750	7784	[illegible]00	0.05

Source:Hajj Research Centre,Jeddah,1984

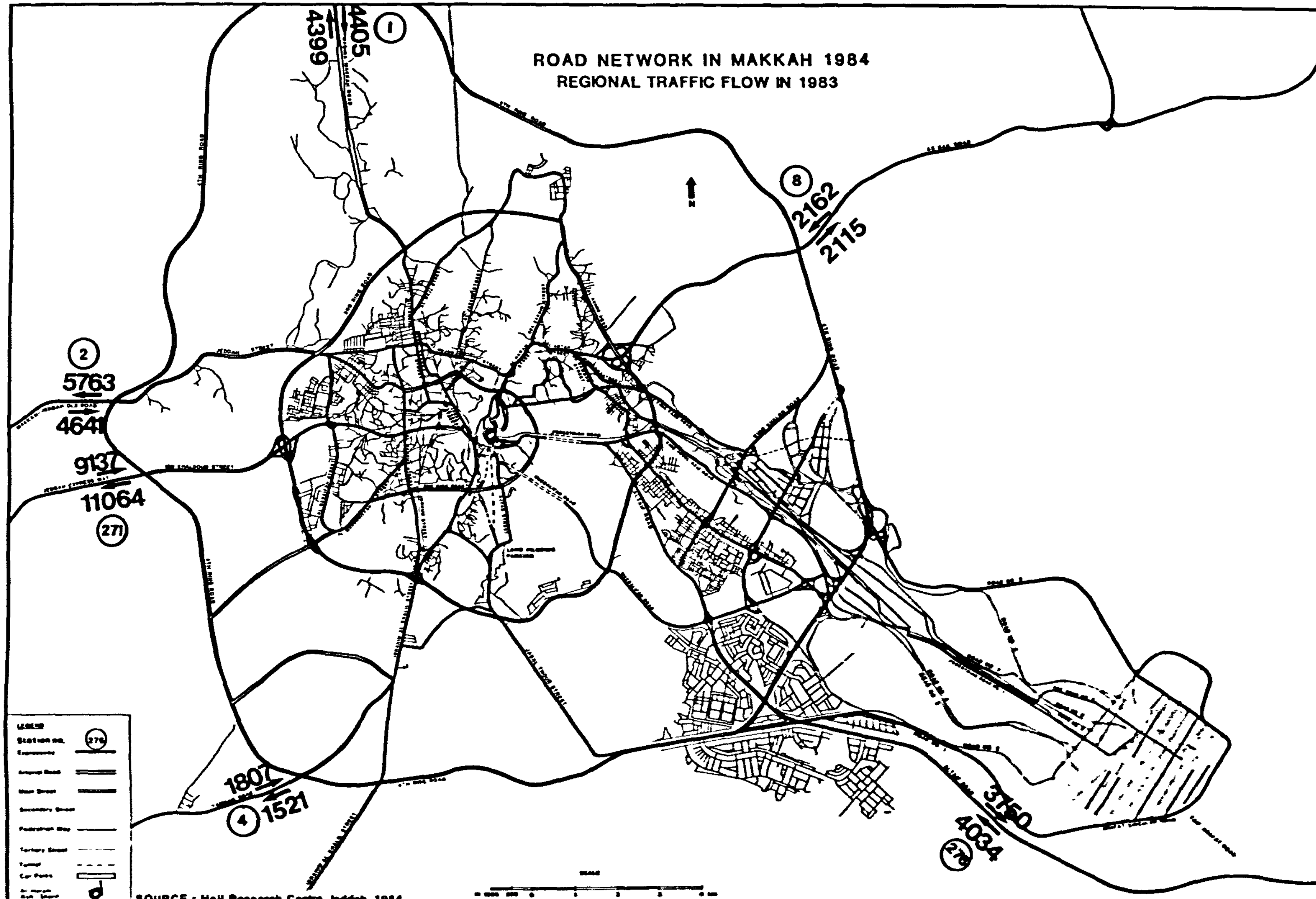

ROAD NETWORK IN MAKKAH 1984
REGIONAL TRAFFIC FLOW IN 1983
1
4405
4399
8
2162
2115
2
5763
4641
9137
11064
271
4
1807
1521
3760
4034
276
SOURCE : Hajj Research Centre Jeddah, 1984

Fig.5.11

Al-Haram. People also journey from Makkah to Al-Taif because of its mild climate during the summer season. Goods are also transported by truck between the two cities.

It can be concluded that the city of Makkah is a vital focal point for traffic travelling to and from it on regional roads.

Table 5.6 illustrates the traffic volume on the city's urban roads. The 24-hour traffic volume on city roads is given in Fig. 5.12 according to direction. From the Table and the Figure, it is noticed that the highest traffic volume was registered on Al-Hjun street (62,120 vehicles in 24 hour period). This street is important because it connects the eastern and western parts of the city. It provides access to traffic coming from the direction of Jeddah old road and travelling to the eastern part of the city. This street passes through a high density district and its commercial area. Traffic congestion and bottlenecks usually occur on this street, but these will be discussed in another section. The other streets which carry a high volume of traffic are: Al-Gararah street, which provides access for most traffic coming from districts in the north of the city and going to Al-Haram; the street near Al-Haram, particularly at Al-Shubaikah Bridge, was busy due to traffic coming from Jabal Al-Kaaba street and Ibn Khaldon street, in the direction of Al-Haram; and Al-Masjid/Al-Haram street was subjected to a high volume of traffic throughout the day, because of serving vehicles leaving the eastern part of Al-Haram for the northern area of the

Table5.6 Characteristics Of Roads In Makkah (1983).

Station No.	Road Name	No. Of Lanes In Each Directn	Type Of Direction System	Peak Hour Volume By Direction	24 Hour Volume A - B	24 Hour Volume B - A	Two-Way 24 Hour Volume	Hourly Capacity By Direction	Peak Hour V/C Ratio	Parking Lane
201	Al-Qararah	4	One-Way	3180	44210	——	44210	1800	1.76	L*
203	Al-Masjid Al-Haram St.	4	One-Way	3000	40148	——	40148	1800	1.66	L & R*
204	Al-Anfaqu Street	3	Two-Way	1210	14133	12852	27015	1200	1.00	
205	North Ajyad Street	3	Two-Way	1228	14557	14668	29225	1200	1.02	L & R
206	Al-Hijrah Street	3	One-Way	697	9322	——	9322	960	0.73	L & R
207	Ibrahim Al-Kalil St.	3	Two-Way	1334	13183	18103	31286	1200	1.11	L & R
208	Shabikah (Near Al-Haram)	3	One-Way	268	3753	——	3753	960	0.3	L
209	Near Al-Haram	2	Two-Way	2183	30933	29566	60519	2400	0.9	
210	Off K.I. Walid & Ka'ba St.	2	One-Way	268	3784	——	3784	960	0.3	
211	Khalid Ibn Walid St.	3	One-Way	1060	14645	——	14645	960	1.1	L
212	Jabal Kaba St.	3	Two-Way	1313	17148	8027	25175	1200	1.09	L & R
213	Al-Tysin Street	4	One-Way	2062	24306	——	24306	1800	1.14	L & R
214	Al-Sulaimaniah Street	2	One-Way	266	3397	——	3397	960	0.3	
215	Amir Fath Street	1	Two-Way	486	4789	2716	7505	600	0.81	
216	Al-Anfaqu Street	3	Two-Way	1386	12331	12037	24368	1200	1.15	L
217	South Ajyad Street	3	Two-Way	390	4642	5050	9692	2250	0.17	
218	Al-Hijrah St.(Missfalah)	4	One-Way	1077	14507	——	14507	1800	0.6	L
219	Ibrahim Al-Khalil St.	3	Two-Way	1414	9081	20012	29093	1500	0.94	L & R
220	Jurham Street	2	Two-Way	465	5458	483	5941	600	0.77	
221	Near Bin Ladin Street	1	One-Way	539	6083	——	6083	600	0.89	
224	Ibrahim Al-Khalil St. (south)	3	Two-Way	571	5918	8276	12194	2250	0.25	
225	Al-Mansur Street	3	Two-Way	150	13725	19657	33382	2250	0.06	L & R
227	Arrassifah Street	3	Two-Way	679	7129	6963	14092	2250	0.30	
231	Al-Njum Street	3	Two-Way	2341	32155	29965	62120	1500	1.56	L & R

*L : Left

*R : Right

Source:Hajj Research Centre, Jedda, 1984

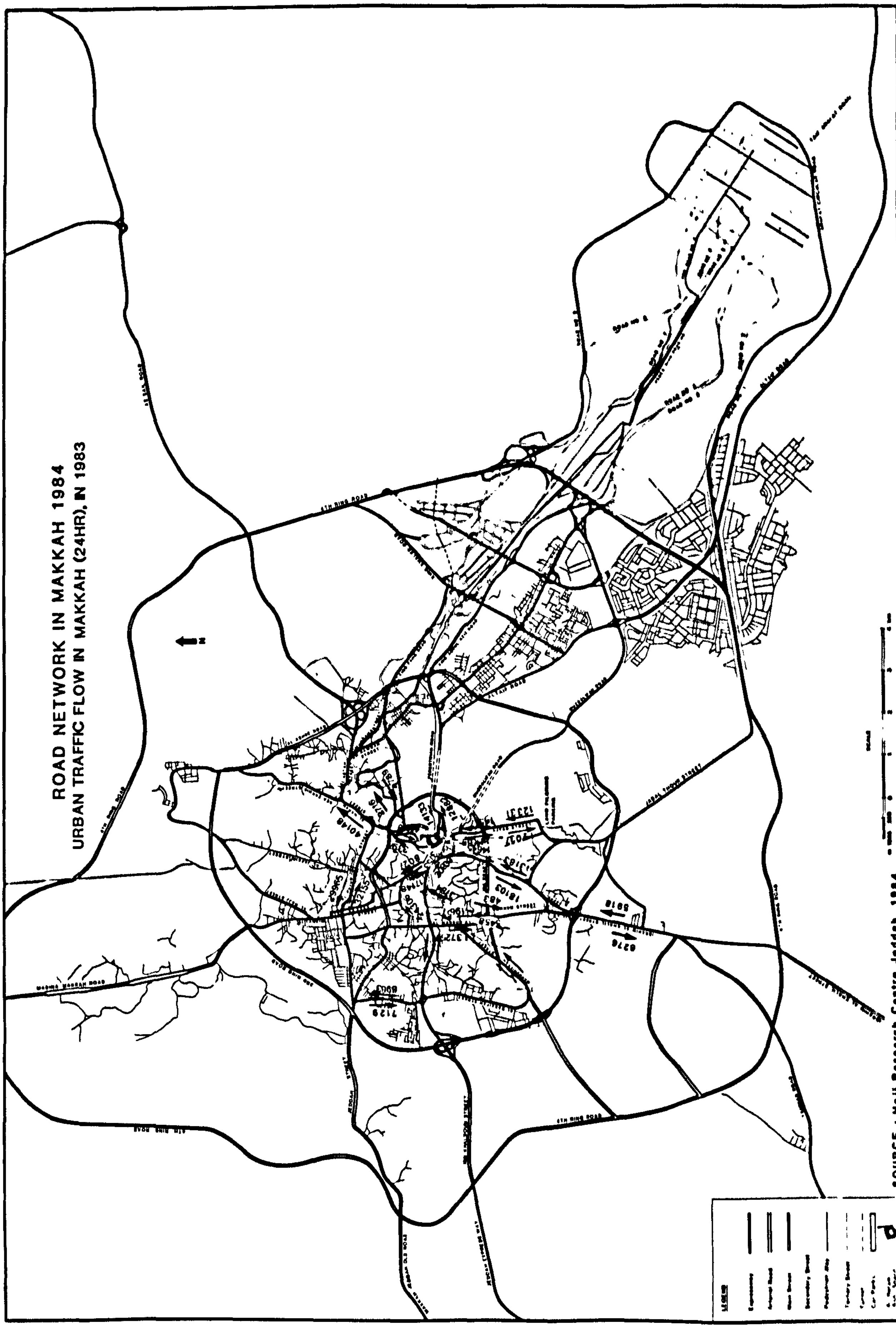

ROAD NETWORK IN MAKKAH 1984
URBAN TRAFFIC FLOW IN MAKKAH (24HR), IN 1983
SOURCE : Hajj Research Centre Jeddah, 1984

Fig.5.12

city. This latter street also experienced congestion and bottlenecks. It can be seen from the Table that Al-Mansur street carried a heavy flow of traffic as a result of passing through a dense residential and commercial area. A few streets carried only a little traffic, but in general the city streets were busy, due to the growth which has taken place.

The speed limits for small cars on the regional roads are: 110km per hour on expressways and 100km per hour on other regional roads. Heavy vehicles have a limit of 70km per hour. On urban roads, the speed limit is 50km per hour for small cars and 30km for lorries etc. (18).

The peak of volume/capacity (V/C) ratio on regional roads varies between 0.03 and 0.05. Generally, it can be said that the V/C ratio of up to 0.8 represents free traffic flow on freeways and expressways, while the ratio of 1.0 represents intermittent and forced flow (19). If the same criteria are applied to urban roads, the V/C ratio on some streets represents intermittent and forced flow with the speed seldom exceeding 50km per hour (20). Referring to Table 5.6, it is noticed that the ratio on some streets indicates that traffic congestion occurs, but this will be dealt with in another section.

5.7.1 Traffic Composition

Data obtained from the Hajj Research Centre show vehicular traffic classified into 16 types. The urban and rural traffic composition according to vehicle type will be compared for the periods during and outside Hajj. This is to ascertain whether use of any vehicle type varies in relation to season. Tables 5.7A and 5.7B show the traffic composition by vehicle type on urban and regional roads of Makkah.

Table 5.7A shows that cars were the most used vehicles on urban and regional roads. In the urban area, cars accounted for 62% of the total vehicle flow, indicative of the high level of car ownership and the great use of cars in the city. The Table also shows that taxis comprise 17.2% of total vehicle flow on urban roads. This proportion is high in relation to the small number of taxis in the city (see Chapter 4), and is due to their ceaseless search for passengers, in the absence of taxi stands. Other types of vehicle form a very small proportion of the total.

On regional roads, the use of cars was also very high, constituting 43.6% of the total vehicle flow. This reflects the great dependence on private cars for travel between cities. This mode of transport is popular because it provides a door to door service in comfort and at speed. While cars were used most on urban and regional roads, the higher proportion was on the former, reflecting a travel pattern.

Pick-ups and all types of truck formed 40.5% of the total vehicle flow on regional roads, reflecting the fact that they were used to transport goods between the cities. The remainder of the proportion, made up of other vehicles, seems rather low.

Table5.7A Traffic Composition According to Vehicle (Urban and Regional Roads) Makkah 1983

Vehicle type	Makkah (%)	Outside Makkah (%)
Motorcycle	0.7	negligible
Car	62.0	43.6
Construction plant (truck)	negligible	negligible
Taxi	17.2	3.6
Pick-up	8.3	16.6
Coach	0.3	0.8
Pilgrim bus	negligible	negligible
Jeep	5.9	9.0
Wannet	2.9	10.7
Water tanker	negligible	1.4
Truck 2-axle	0.4	9.8
Truck 3-axle	0.1	2.0
Truck over 3-axle	negligible	1.2
Minibus	0.3	0.4
SAPTCO bus (single deck)	1.6	0.7
SAPTCO bus (double deck)	0.3	negligible
Total	100.0	100.0

Source:Hajj Research Centre,Jeddah,1984

Table5.7B Composition of Traffic According to Vehicle and Regional Roads) Makkah 1983

Vehicle type	Non-Hajj (%)	Hajj (%)
Motorcycle	0.7	2.2
Car	62.0	38.7
Construction plant (truck)	negligible	0.2
Taxi	17.2	12.3
Pick-up	8.3	7.4
Coach	0.3	0.7
Pilgrim bus	negligible	2.8
Jeep	5.9	19.2
Wannet	2.9	6.4
Water tanker	negligible	2.2
Truck 2-axle	0.4	0.8
Truck 3-axle	0.1	negligible
Truck over 3-axle	negligible	negligible
Minibus	0.3	4.5
SAPTCO bus (single deck)	1.6	2.0
SAPTCO bus (double deck)	0.3	0.6
Total	100.0	100.0

Source: Hajj Research Centre, 1984 Jedda, Saudi Arabia

Comparing the composition of traffic according to vehicle type on urban roads during and outside the period of Hajj, it can be seen from Table 5.7B that there is less use of cars during Hajj. In order to avoid congestion, cars with capacity for fewer than nine passengers are prohibited from the city streets and holy sites (Arafat, Mina and Muzdalifah) during Hajj [21]. The use of coaches predominated during Hajj, while the use of pilgrim buses did not feature outside Hajj. These latter are stored in garages and operate only during Hajj, transporting pilgrims between Jeddah, Makkah, Al-Madina and the holy sites of Makkah. The use of mini-buses and SAPTCO buses (single and double decker) was greater during Hajj due to the restrictions placed on small cars and the influx of pilgrims.

5.7.2 Vehicle Occupancy

Table 5.8 shows vehicle occupancy in Makkah. The average figure for cars and jeeps was 1.85 passengers. The average occupancy of mini-buses was 9.39, being low in relation to their capacity of 18 persons. The average occupancy of all vehicles in the city was found to be 1.91.

Table 5.8 Vehicle Occupancy Makkah 1983 (Urban)

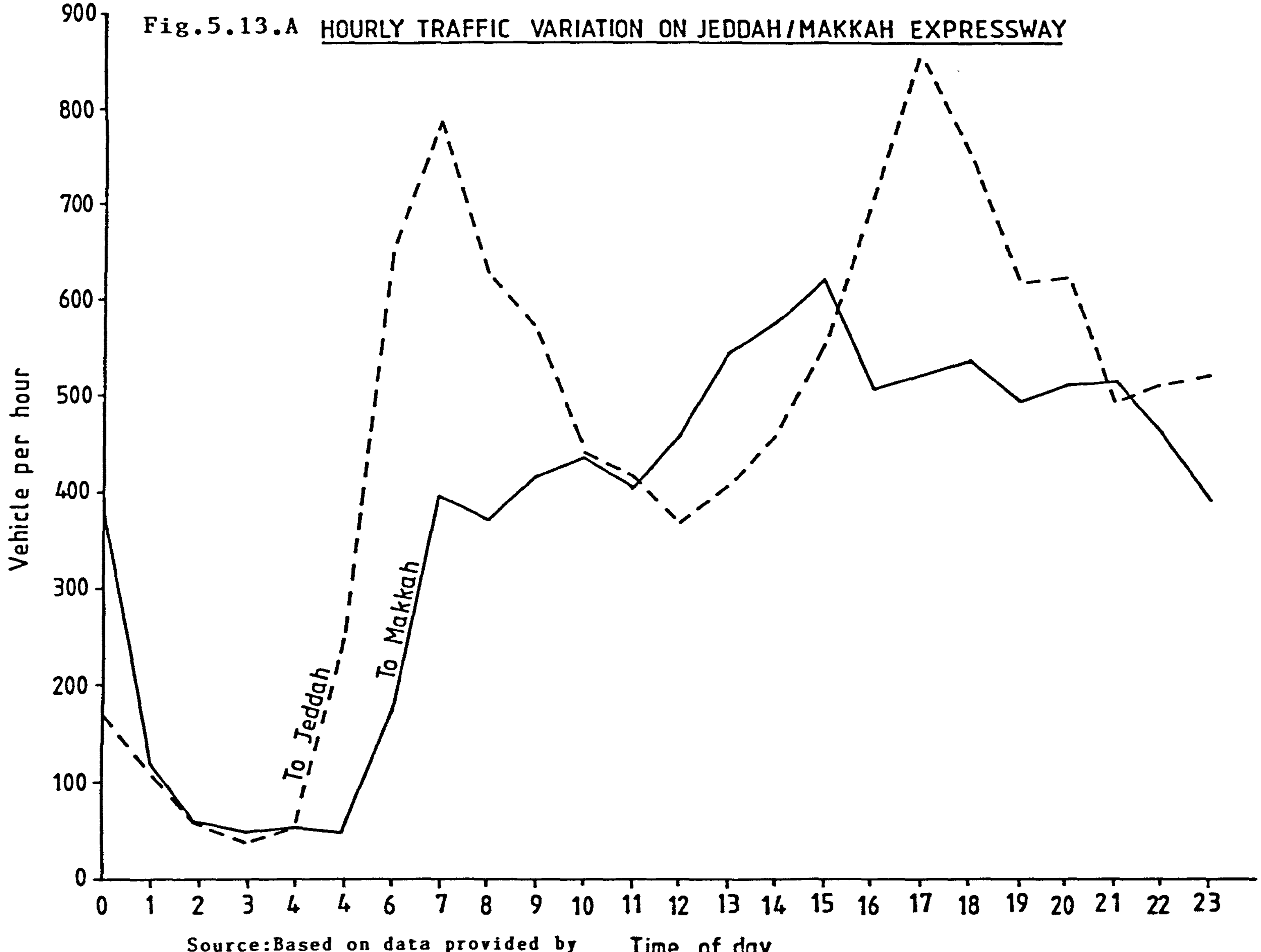
Vehicle type	Average occupancy
Car, jeep	1.85
Taxi	1.71
Pick-up	1.72
Minibus	9.39
All trucks	1.56
All vehicles	1.91

Source: Hajj Research Centre, 1984 Jedda, Saudi Arabia

5.7.3 Daily Traffic Variation

Fig. 5.13A illustrates the traffic variation on the Jeddah/Makkah Expressway. The traffic volume on this regional road builds up sharply after 04.00 and reaches a distinctive peak at 07.00. After this peak, traffic volume gradually declines until 12.00. A second peak starts to build up after noon and rises sharply to reach an evening peak at 17.00. The subsequent slow decline reaches its lowest point at midnight. The two peaks indicate the daily travel pattern. The morning peak results from people travelling to work and visitors travelling to and from the city. The evening peak occurs when the workers return home. Evening is also a time when visitors may come to the city, or inhabitants leave to visit Jeddah.

Fig.5.13.A HOURLY TRAFFIC VARIATION ON JEDDAH/MAKKAH EXPRESSWAY



Source:Based on data provided by Hajj Research Center,Jeddah,Saudi Arabia.(1985).

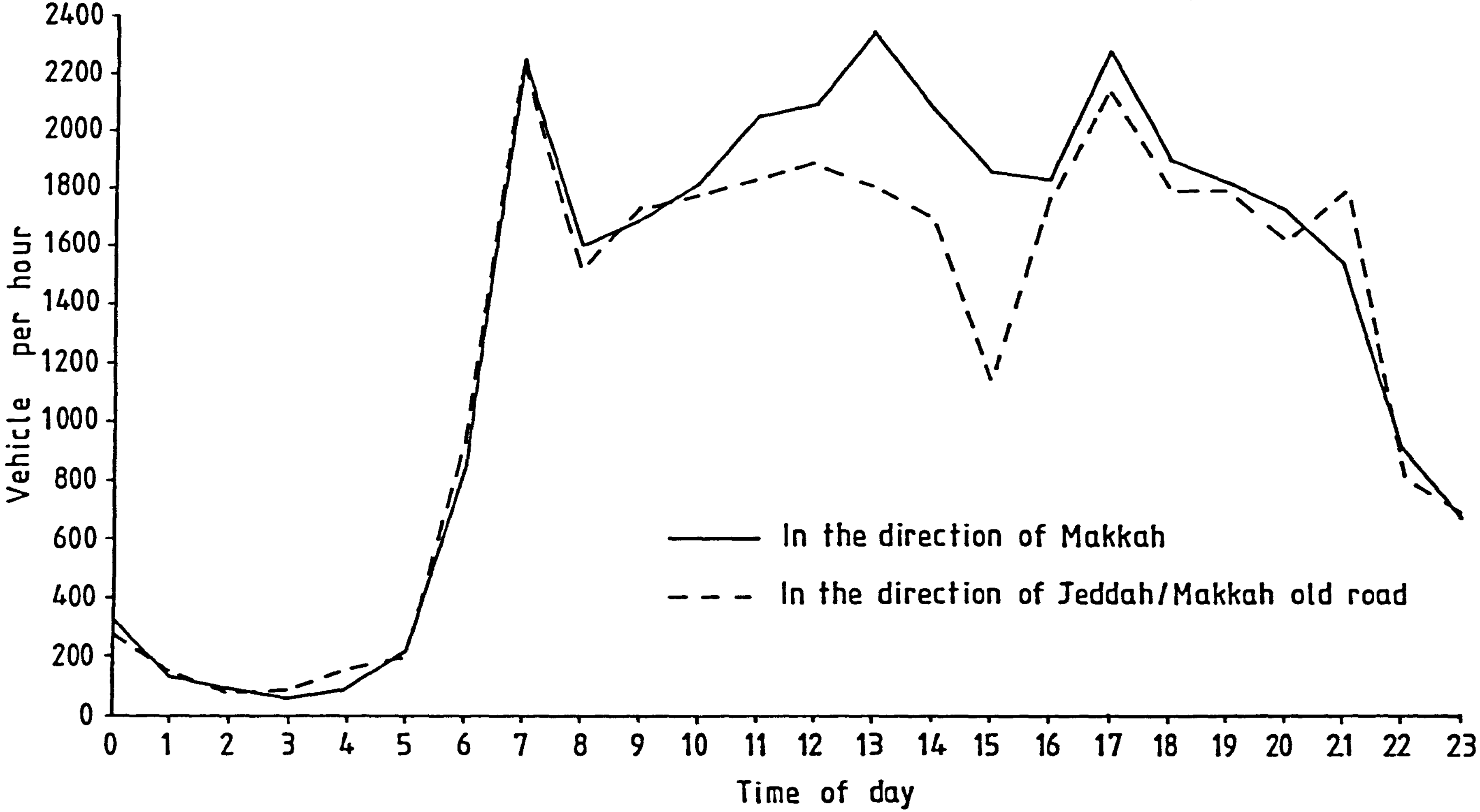
On the city streets, the volume of traffic builds up sharply, with people travelling to work, schools and shops, the peak usually occurring at about 07.00. Then there is a fall before a second peak builds up, and occurs around 13.00 when people return home. The evening peak at 17.00 is augmented by people going to Al-Haram, shopping, socialising etc. Another small peak occurs in the evening when these people return home (see Fig. 5.13B).

5.7.4 Congestion and Bottlenecks

Sometimes traffic congestion in the city reaches a level that is dangerous. As observed by the author in 1984 and 1985 when conducting fieldwork, various factors cause road traffic congestion on the city network. One is the poor road geometry, another is the parked vehicles on the streets. Vehicle flow is impeded due to the presence of pedestrians on city streets, thereby increasing the necessity for repeated stopping and starting. Moreover, a build up can be caused at traffic lights where some drivers speed up to be near the beginning of the queue and others slow down to avoid a collision with them.

One of the most congested areas is Al-Haram area and the streets leading to it, owing to the large number of vehicles and pedestrians which converge on this area. Not only does the presence of pedestrians cause traffic hold-ups, but it also creates a safety hazard (see Plate 5.1). Vehicles travelling

Fig.5.13.B HOURLY TRAFFIC VARIATION ON AL HUJUN STREET



Source:Based on data provided by Hajj Research Cener,Jeddah
Saudi Arabia.(1985).

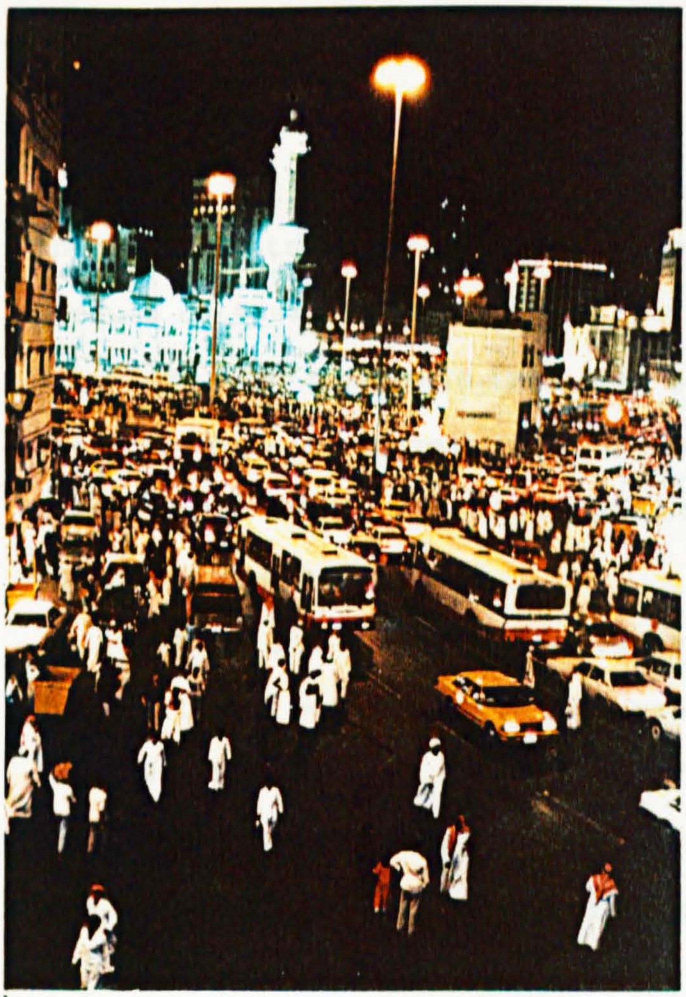


Plate 5.1

Pedestrians and vehicles mingle on the roads in central Makkah causing delays, safety hazards and environmental problems.
(Photo: Z.A. Mekki, 1986.)

Plate 5.2

Street layout near Al-Haram creating a bottleneck for vehicles.

(Photo: Z.A. Mekki, 1986.)

specifically to Al-Haram cause congestion to other road users, because of their volume and the fact of stopping to set down passengers. Car parking in this area also creates bottlenecks. There is normally congestion around Al-Haram before and after prayer time, but this is exacerbated on Fridays and during the seasons of Ramadan and Hajj.

Al-Masjid/Al-Haram street experiences traffic congestion, since all cars entering Al-Haram area from west and east must leave via this street. A build up of traffic occurs near the multi-storey car park due to a bottleneck which has been created by a narrow street on which there are historic buildings (see Plate 5.2).

As mentioned previously, Al-Hejoon street becomes very congested as a result of traffic converging from east and west sides of the city. Parking along the street creates further problems, as does the presence of shoppers and inhabitants wishing to cross the street. (It will be recalled that this street passes through dense commercial and residential areas.) Traffic congestion usually occurs on this street in the morning when people travel to work and school, and later when they return home. Moreover, further congestion is evident in the evening when large numbers of shoppers come to the commercial area. During the afternoon, there is a problem near a bakery to which many people come to buy fresh bread for their evening meal. Customers usually park nearby and on both sides of the street.

Sometimes cars are double parked, thereby creating a bottleneck.

Other points on the city network that experience traffic congestion are: Abrahim Al-Khalil street; Ibn Khaldon street; Al-Mansoor street, Jarwal street; and Al-Tyseer street. These all have traffic congestion, resulting from parked cars and people crossing in order to do their shopping etc. An additional problem is traffic build-up at street intersections such as Al-Rasifah (Al-Steen street) and Jeddah street; also at Al-Shubaikah Bridge.

5.7.5 Traffic Patterns: Conclusion

It is apparent from the previous discussion that the city of Makkah experiences a high volume of traffic on both its regional and urban roads, owing to the rapid increase of vehicle ownership in the city. The traffic flow to and from Makkah reflects its importance, with Al-Haram being the dominant focal point. The rapid increase of vehicles and their use in the city, the parked cars on the city streets, the uncontrolled pedestrian flow and the design of some streets, all together play a significant role in causing traffic congestion which requires a combination of solutions to relieve these problems and to achieve a smoothly flowing city traffic network.

5.8 Road Traffic Noise in Makkah, 1986

The world we live in today has seen tremendous technological development and progress. The technology of today makes the life of man easier than ever before. One of the examples is the invention of motor vehicles, making it possible to cover distances which would be impossible on foot. Although technology brings advantages, there are also some disadvantages, namely noise and pollution, which are partially attributable to motor vehicles.

> There is abundant evidence that the noise from motor vehicles is a source of distress to the public and is indeed often the major source of annoyance due to excessive noise (22).

This raises the question as to how a vehicle causes noise, the answer to which is the subject of the next section.

5.8.1 The Causes of Vehicle Noise

In 1963, the Wilson Report found that

> ... in London (and no doubt this applies to other large towns as well) road traffic is ... the predominant source of annoyance and no other single noise is of comparable importance (23).

The causes of vehicle noise stated in the Wilson Report can no doubt be applied to the city of Makkah, where cars are used extensively. The causes of vehicle noise stated in that Report will be summarised here to give a clear picture as to how vehicles in Makkah may be considered a source of noise.

5.8.1.1 Propulsion Noise

The ordinary observer cannot easily distinguish between noise from the engine, exhaust and transmission, which result essentially from the mechanical propulsion of the vehicle, nor can he measure them separately. However, the committee on the problem of noise considers them together and not individually.

Numerous vehicle manufacturers have done much to reduce the emission of noise. These manufacturers are among the few larger scale makers of machinery who have, over many years, regarded the reduction of noise as an important part of their business. Nevertheless, there is clear evidence that, amongst certain classes of vehicles, noise levels are higher than need be, given the knowledge at present available to manufacturers and, indeed, in a few cases, the emission of a particular exhaust noise appears to be a deliberate part of the design for sale purposes.

The reduction of exhaust noise is usually a clear cut problem, the theoretical solution of which is known. Practically, it may involve the manufacturer or purchaser in extra cost, weight or loss of performance. However, the committee on the problem of noise considers that more work is needed on this aspect and that manufacturers should be encouraged to take greater advantage of the existing knowledge.

In the case of some high performance motor cycles and many diesel engined cars, the sound of the engine is as great as that of the exhaust and this proves to be a more difficult problem to correct. Existing knowledge in this sphere is by no means complete and the solution might involve re-design of the engine or enclosure, resulting in greater weight and cost. The committee recommends that further engineering research is required.

5.8.1.2 Horns

Noise from motor horns does not appear to cause undue annoyance and, in general, motorists use them with restraint. Occasionally, they are used without justification.

In our study of the traffic noise in the city of Makkah, the use of horns was considered another source of noise. Motorists often hoot at traffic lights when they turn green in order to urge drivers in front of them to move off more speedily. Horns are also used at important centres such as mosques, hospitals and schools. Thus, they are considered a source of unacceptable noise. In 1971, the General Traffic Department issued a law restricting the use of horns unless absolutely necessary [24]. It is therefore strongly recommended that motorists curb their use of horns in order to reduce the noise level.

5.8.1.3 Squealing Brakes

People living near bus stops, traffic lights and other places where drivers are likely to use their brakes are frequently annoyed by the squealing of brakes.

5.8.1.4 Slamming Doors

There is evidence of a great deal of annoyance being caused by the slamming of car doors. The committee suggests that the public should be made aware of the fact that less force is required to shut car doors. Often, unnecessary force is used which distorts the car body, making it more difficult subsequently to close the door quietly.

5.8.1.5 Loads

The committee has found that loaded lorries can create noise annoyance, but that empty tankers can also cause disturbance (25).

5.8.2 The General Effects of Noise

Noise forms a potential health hazard. One effect is hearing damage.

> There is clear evidence that levels in excess of 90 db (A) received over an extended period are injurious to hearing and damage may be sustained much earlier at higher levels. (26).

In addition to this, traffic noise has other major effects. These effects, as stated by Susan Hanson, are:

> Sleep interference, speech interference, annoyance and the impairment of hearing (27).

5.8.3 The Aims of Measuring Noise in Makkah

It is apparent from the foregoing discussion that traffic noise causes trouble to the public. Noise pollution has been studied in most advanced countries, but unfortunately not in every country in the world.

In Saudi Arabia and particularly in Makkah, noise pollution is caused by the massive traffic flow in the city. This is increased during Ramadan and Hajj. Unfortunately, government agencies, the city planner and residents seem unaware or indifferent to the gravity of the problem and its effects on national health.

The purpose of this part of the study is to measure the traffic noise level in the city in order to discern whether or not it is causing a serious problem. Also, its level will be compared with the international noise level standard. It is intended to make recommendations to improve and protect the public health and city environment. To this end, a survey was conducted to measure the level of traffic noise in Makkah. This is the first study to consider such environmental problems in Makkah and it will be the subject of the next section.

5.8.4 Methods of Measuring Noise Level

In order to conduct the traffic noise level measurement survey in the city, 20 districts were selected at random and coded from 1 to 20 (Fig. 5.14). The city centre was the greatest concern and four places were selected for measurement. They were mainly located around Al-Haram area. An XER-430-V sound level indicator machine was used. This machine covers the range 36-110

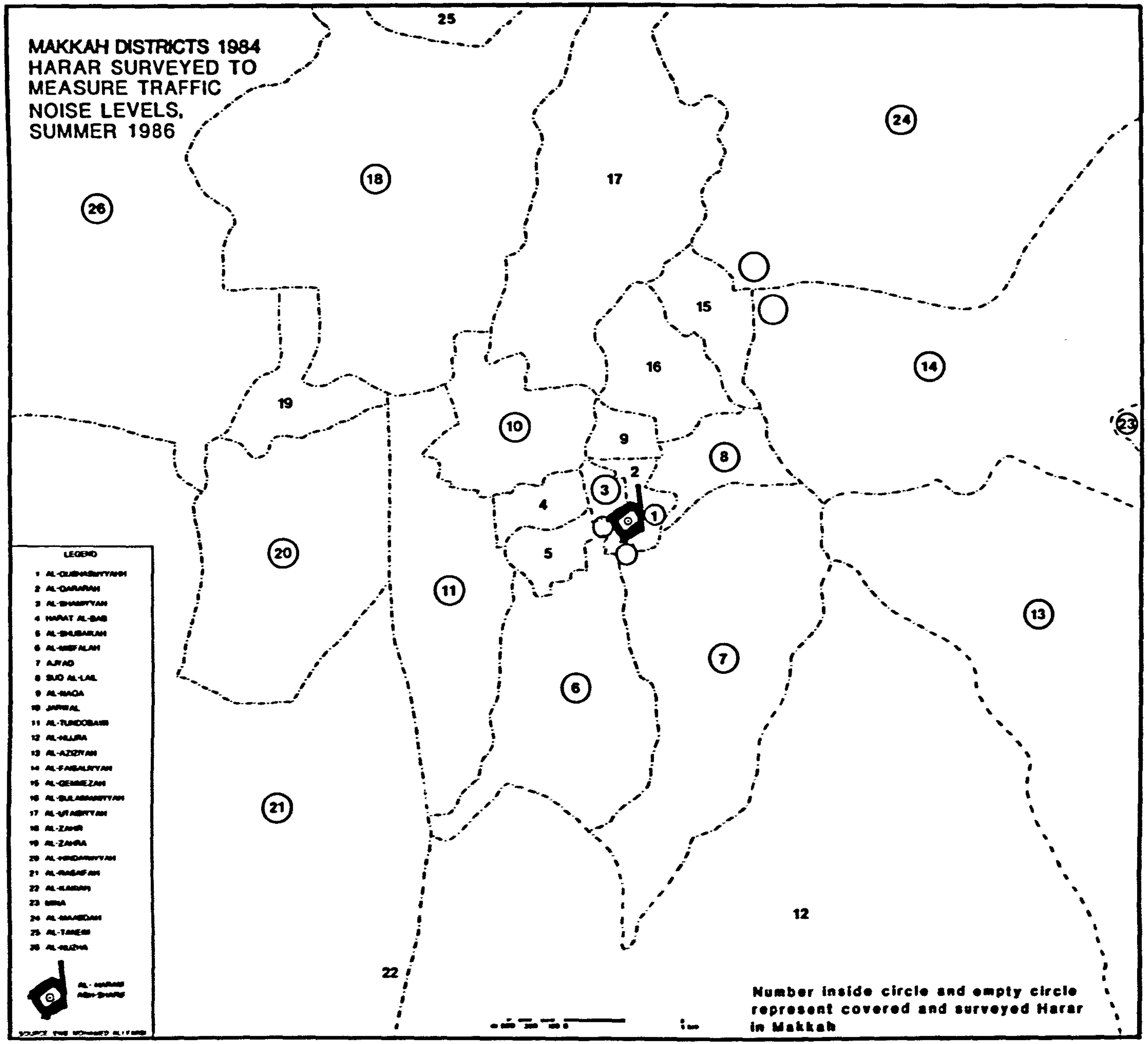

MAKKAH DISTRICTS 1984
HARAR SURVEYED TO
MEASURE TRAFFIC
NOISE LEVELS,
SUMMER 1986
LEGEND
4 HARAT AL-BAB
7 AJYAD
8 SUQ AL-LAIL
19 AL-ZAHRA
23 MINA
Number inside circle and empty circle represent covered and surveyed Harar in Makkah

Fig.5.14

decibels. It was held in the hand at a height of one metre from the road surface and at a distance of two metres from the source of the noise. The highest reading from the machine was registered for each geographical direction. One minute was allocated to register for every location selected. The measurement points were 10 minutes apart and a motorcycle was used to achieve uniformity and speed. Measurements of level of traffic noise were carried out from the end of the month of Ramadan to the beginning of Shawal month in 1986. The reason for selecting two months is because the former is a time of religious ceremonies, while the latter represents a normal, everyday period. This being the case, it is possible to draw comparisons between the two. For each, five days were chosen, including weekdays and weekends. This would demonstrate whether there was a significant difference in noise level between the latter two. The survey sheets were divided into sections so that they could be filled in immediately, giving details of station (district) number, location, time of day and date and four boxes for geographical direction in which noise level could be registered. There was also a space for additional comments.

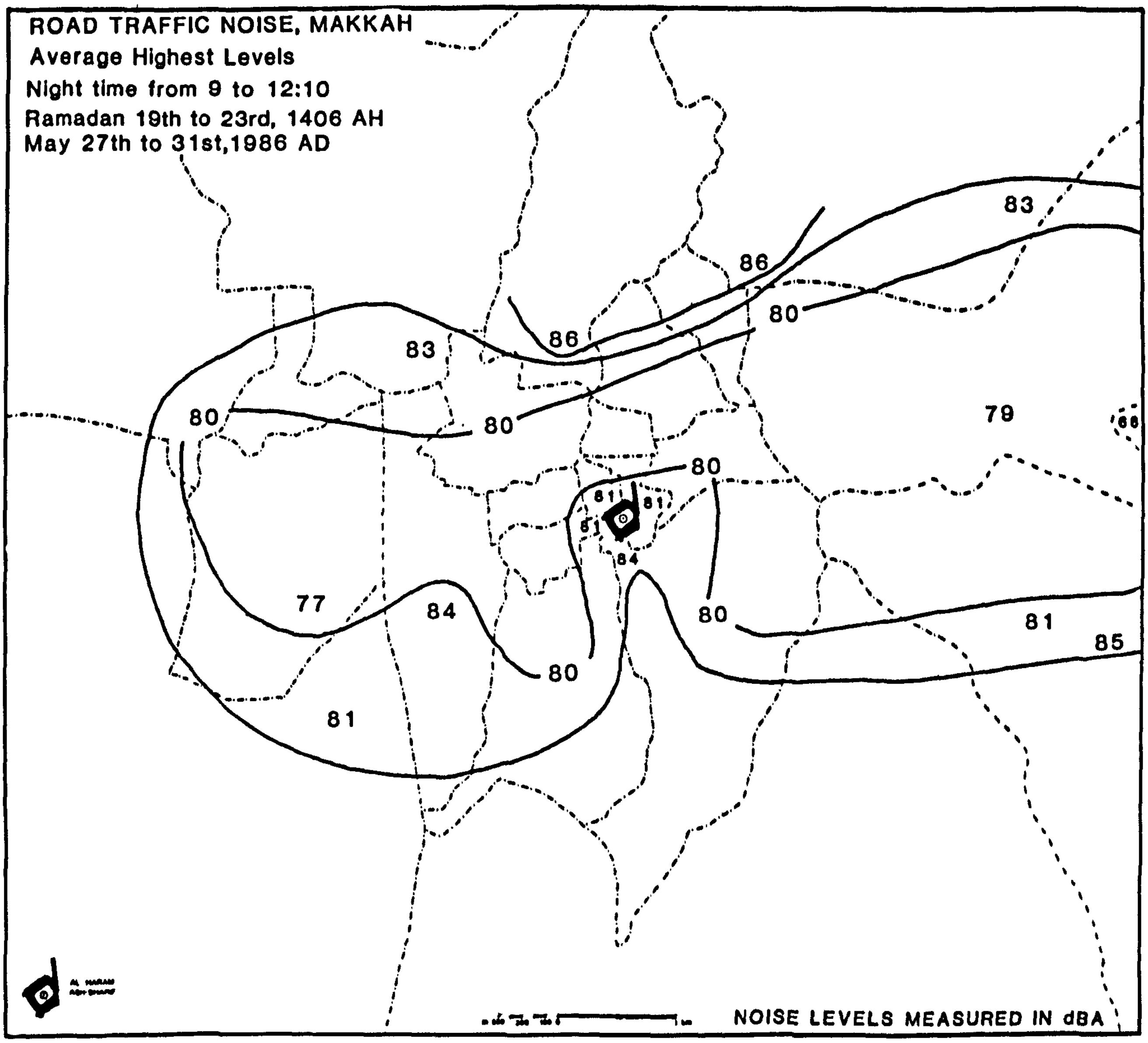
5.8.5 The Spatial Variation of Noise According to Time

The purpose of this section is then to establish how noise levels vary between different hours, day and night. Additionally, it is intended to discover whether the levels differ in relation to the different seasons. The readings taken at selected sites were connected by lines to establish a boundary for identifying critical noise areas in the city (Fig. 5.15A to H). The data on traffic noise level represented the sound received from all types of vehicle joining the flow.

During Ramadan 1406AH (May 1986AD) in daylight, 17 sites (numbers 1, 3-14, 17, 18, 19 and 20) experienced noise between 70-75 decibels on average, for five days and in four geographical directions. The highest average reading for five days was 73-78 decibels. These areas are located north, south, east and west of the city centre. The highest noise levels are associated with sites 8 and 10, due to traffic flow in and out of the city centre. These points are situated just to the east of Al-Haram.

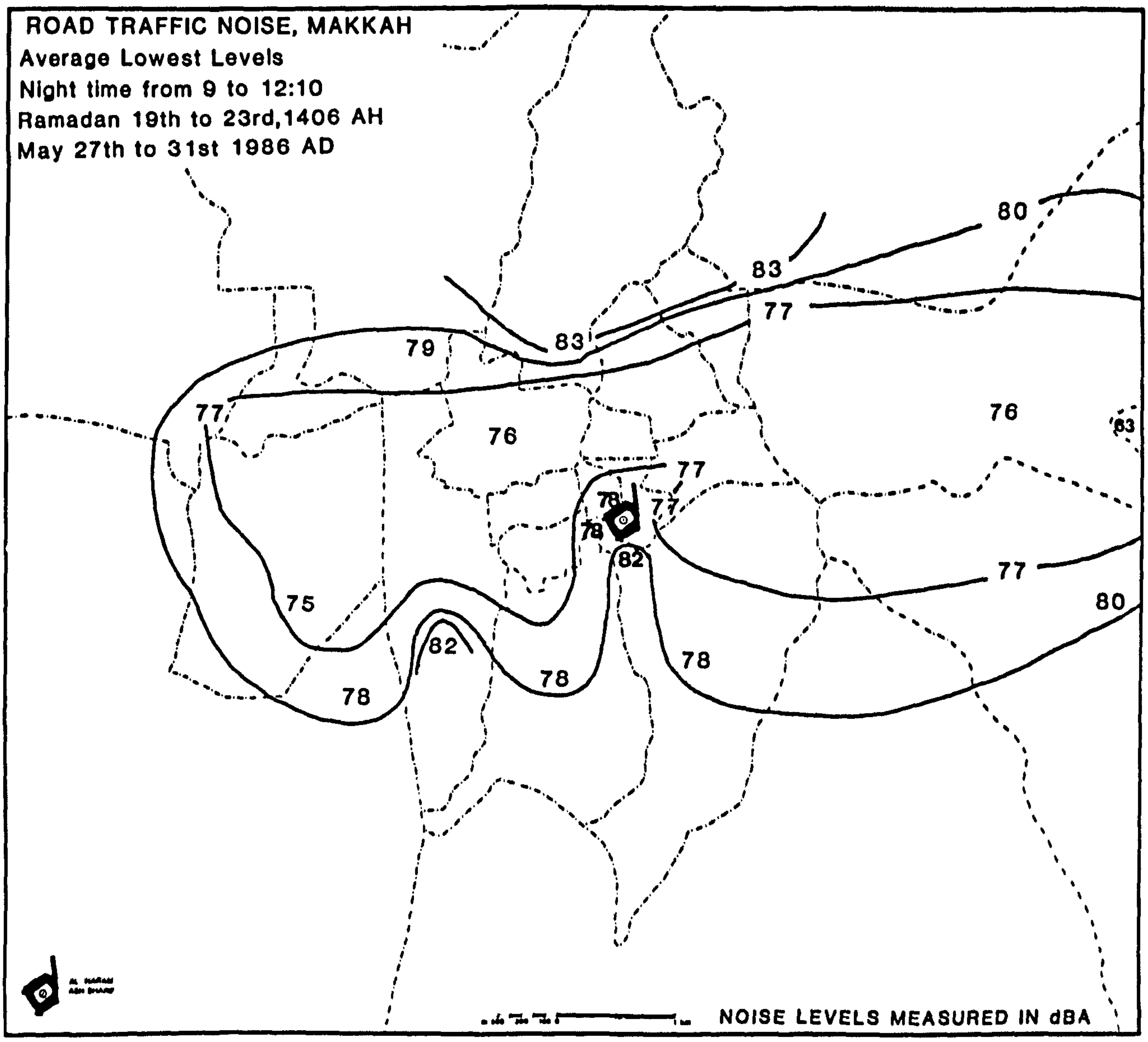
At night during Ramadan, 19 sites (numbers 1, 2-14 and 16-20) experienced a noise average of between 75-83 decibels for five days in the four geographical directions, while the highest average was 75-86 decibles. During Ramadan, the highest noise level at night was associated with stations 16, 17, 3, 6, 12, 18, 8, 7, 5, 4, 1, 19, 14, 13, 10, 9, 20, 11 and 2, where traffic passed these areas taking visitors to and from Al-Haram and various other centres in the city. Measurements indicate that locations 16 and 17 were subjected to noise levels between 83-86 decibels. Heavy trucks coming from Al-Hajj street and travelling north in the direction of Al-Taif passed site 16 and heavy traffic coming from Jeddah old road and that going to and leaving the commercial area, passed site 17. Sites 3 and 6 were

Fig.5.15.A



Source:Field Work ,Makkah.(1986)

Fig.5.15.B



Source:Field Work,Makkah.(1986)

Fig.5.15.C

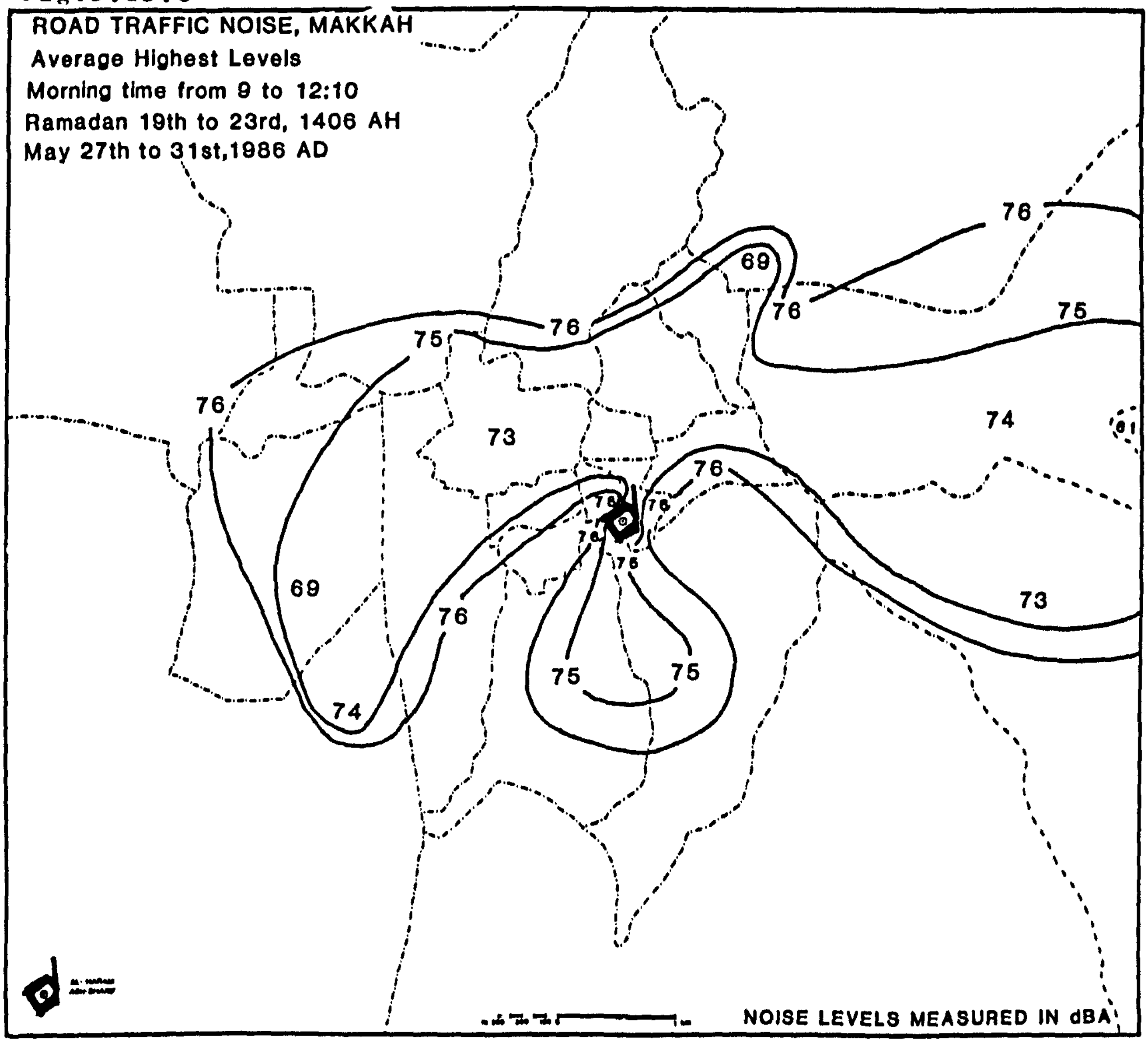
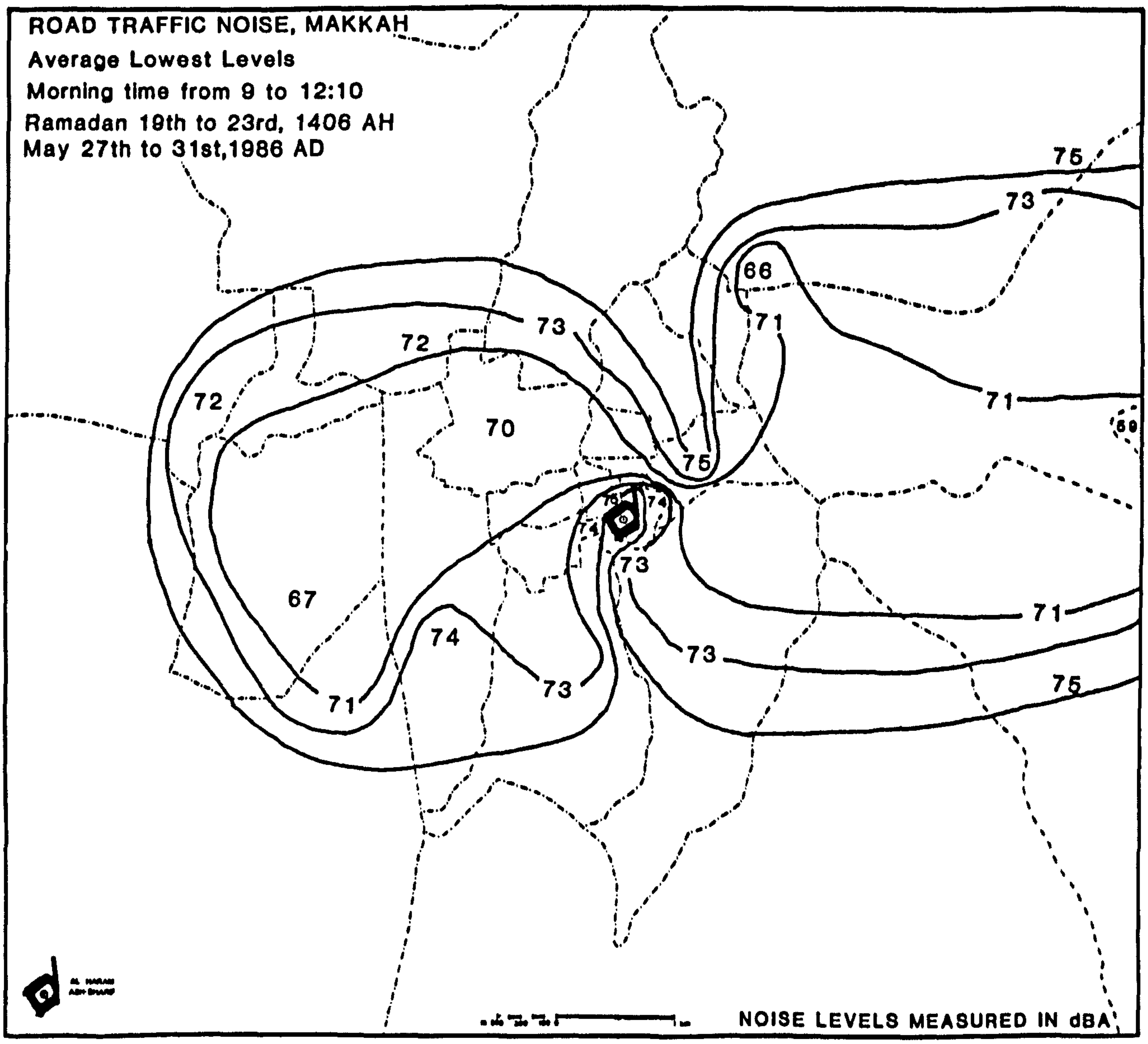
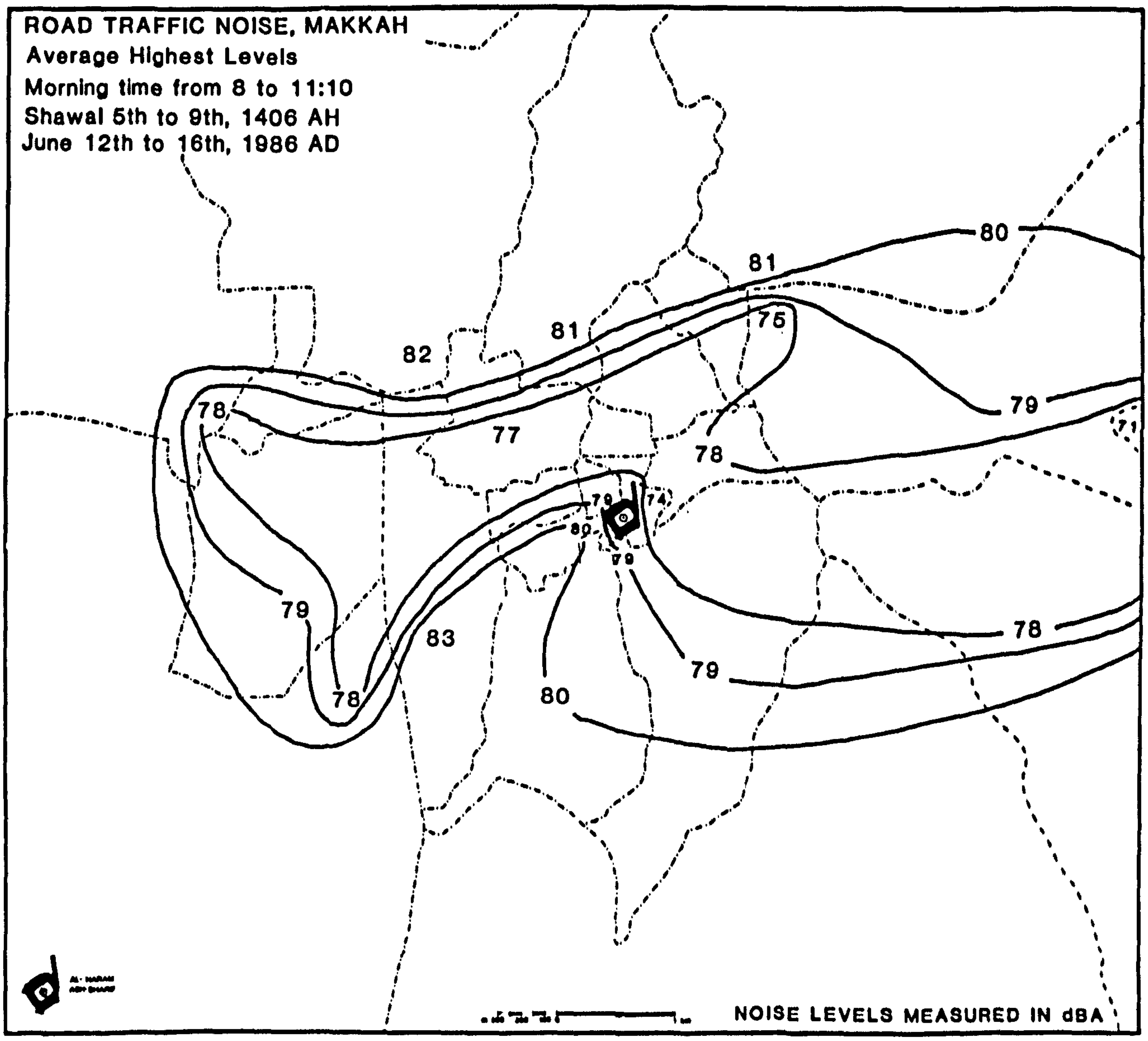

ROAD TRAFFIC NOISE, MAKKAH
Average Highest Levels
Morning time from 9 to 12:10
Ramadan 19th to 23rd, 1406 AH
May 27th to 31st,1986 AD
76
69
76
75
76
75
76
74
73
76
69
76
74
75
75
73
NOISE LEVELS MEASURED IN dBA

Fig.5.15.D



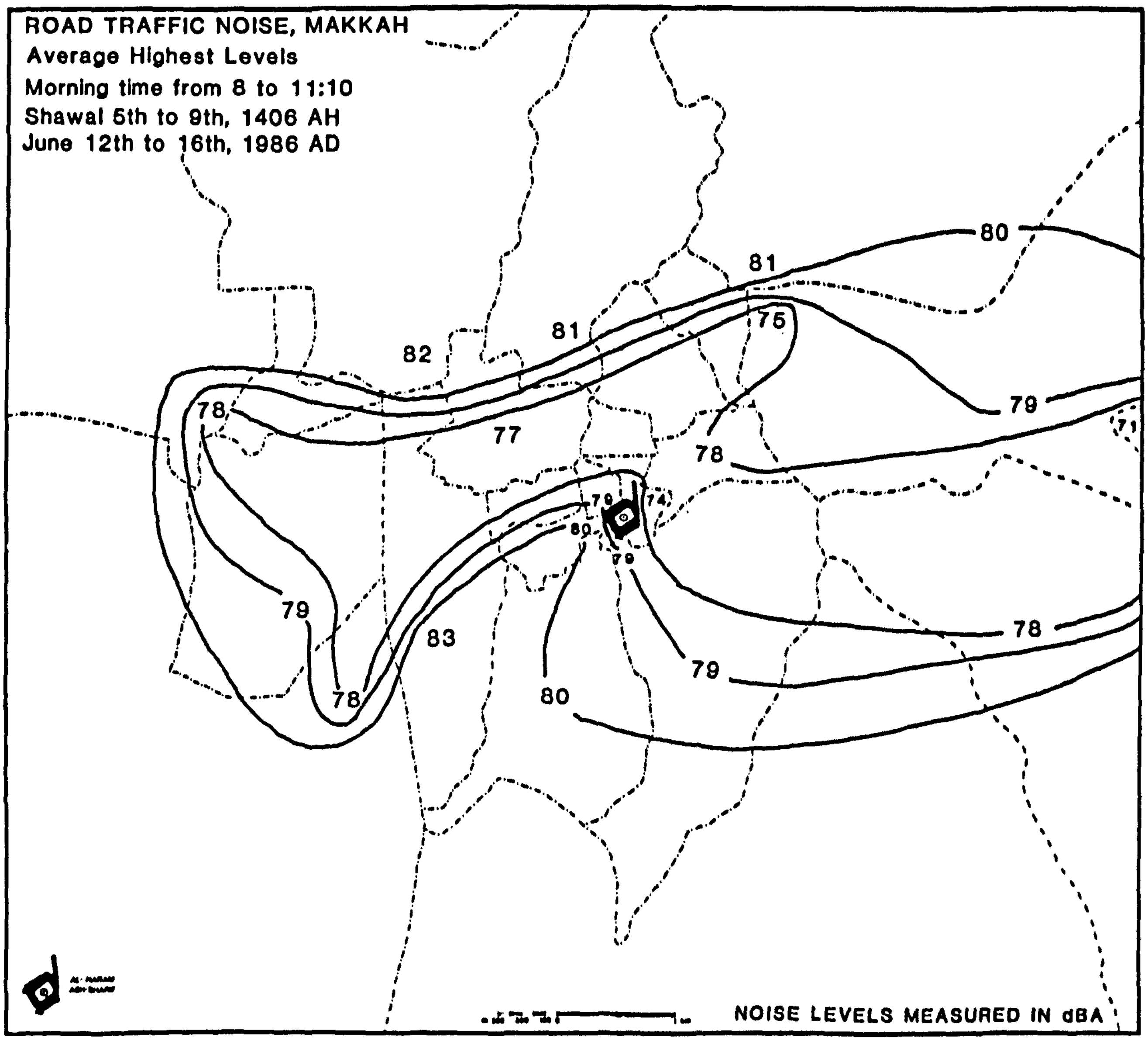
Source:Field Work .,Makkah.(1986)

Fig.5.15.E



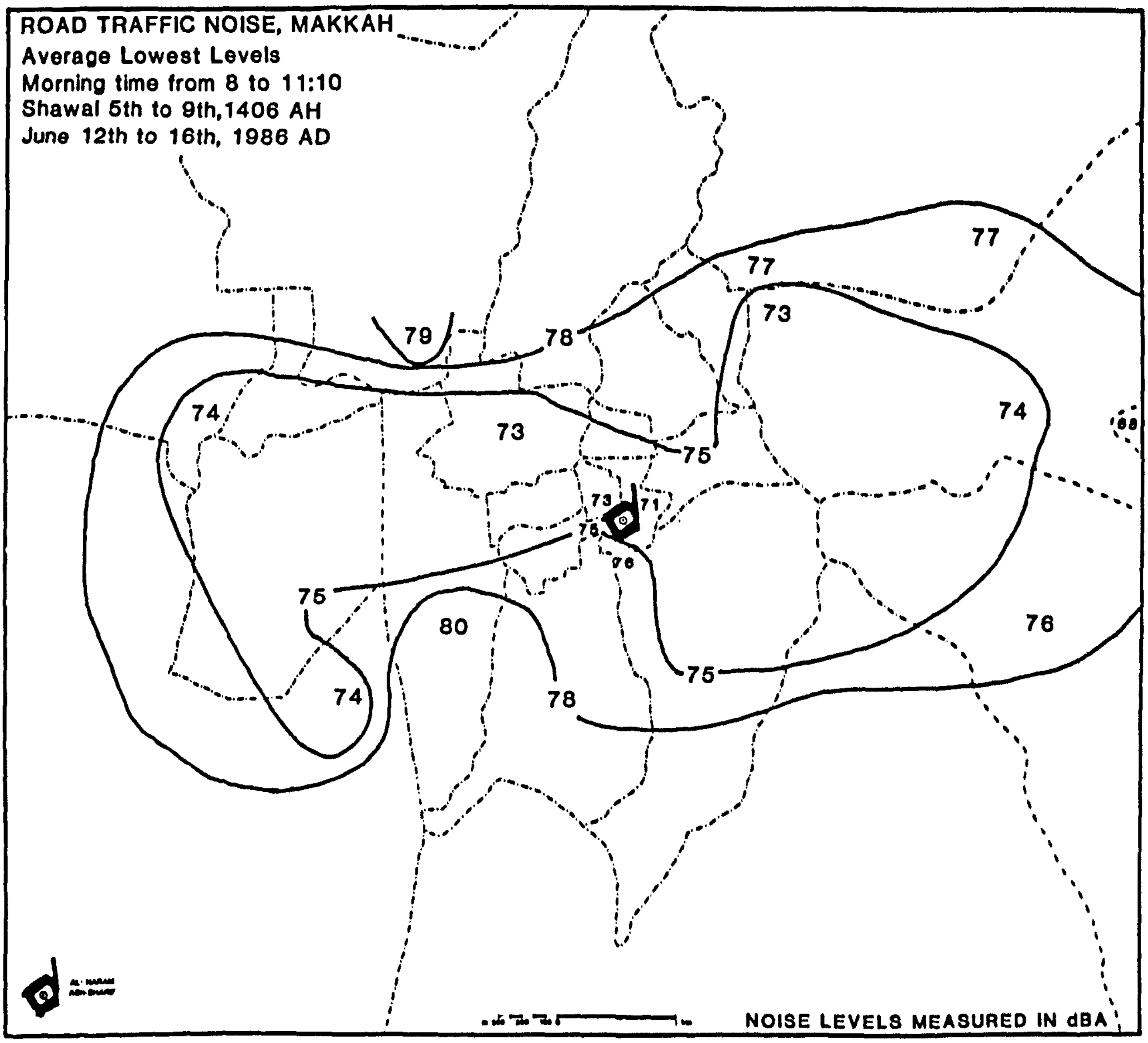
Source:Field Work ,Makkah.(1986)

Fig.5.15.F



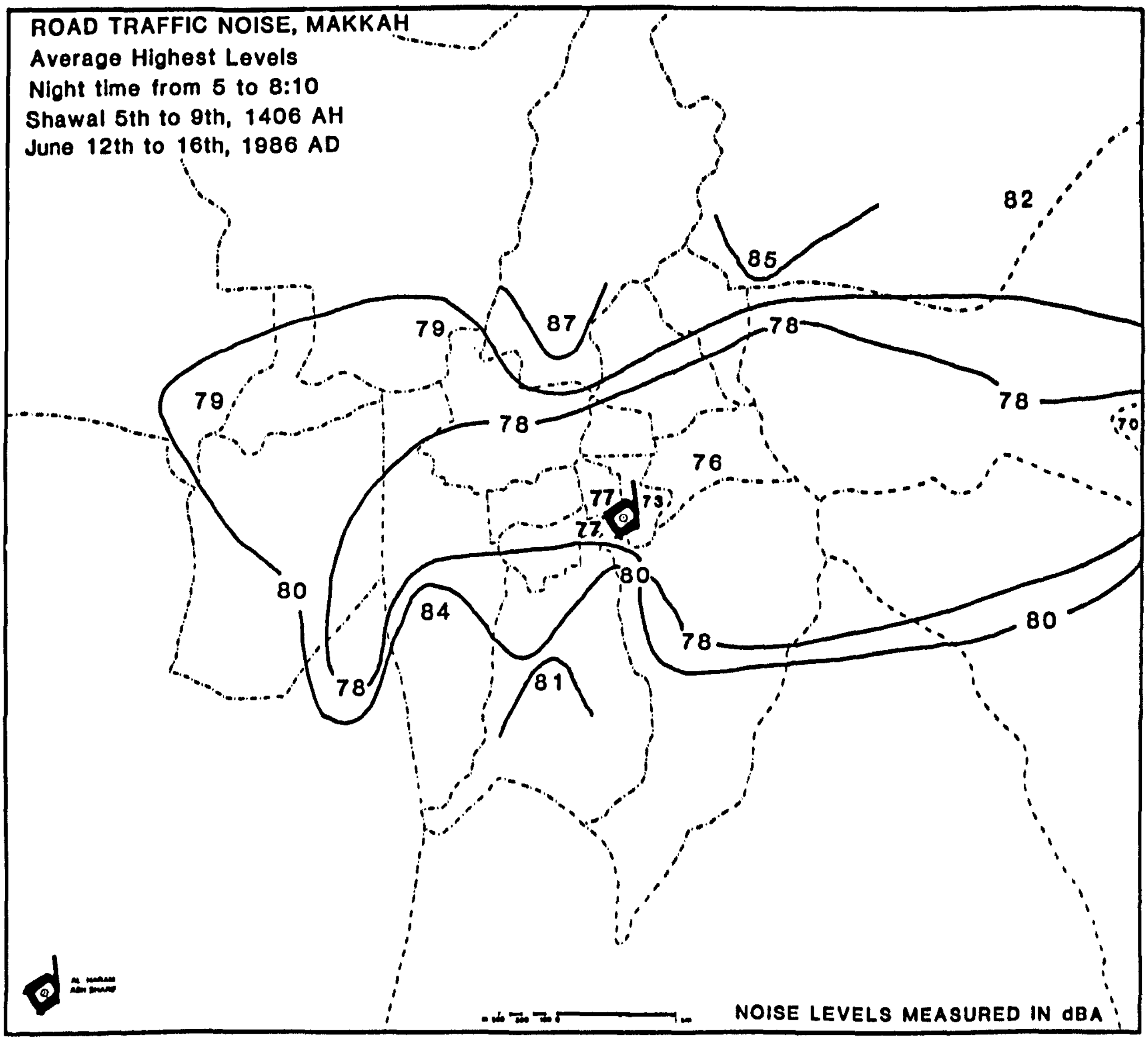
Source:Field Work,Makkah.(1986)

Fig.5.15.G



Source:Field Work.,Makkah.(1986)

Fig.5.15.H



SOURCE:Field work, Makkah,1986.

subjected to noise levels between 82-84 decibels. Site 3 was subjected to massive traffic flow due to vehicles crossing the street and because it is in a commercial area. Location 6 is sited at Al-Haram where the noise was related to the heavy volume of traffic connected with Al-Haram, together with the vast number of pedestrians which impeded the flow of traffic, causing it to stop and start, hence the tremendous range in the reading. This was also affected by times of prayer (04.30, 12.00, 16.00, 18.00 and 19.30). The level at site 12 was between 80-83 decibels due to the fact that it is a densely populated area. The fact that King Abdulaziz hospital is situated in area 18 caused it to register 79-83 decibels. Sites 1, 4, 5, 7 and 8 were subjected to noise ranging between 78-81 decibels. Sites 7 and 8, situated near Al-Haram, experienced the same level as 6. Since sites 1, 4 and 5 are located in commercial areas the noise level was high at these points. The same was true of 9, 10, 11, 14 and 19. These latter attracted customers, thereby increasing the level of transportation. Educational and health establishments at locations 13, 14 and 19 were definitely affected by traffic noise. Point 9 was subject to the same noise pattern as 6 and 8. The level at locations 2, 11 and 20 was between 75-80 decibels, due to their being commercial areas attracting customers. Finally, during Ramadan by day and night, site 15 experienced a noise level of only 59-66 decibels, due to the fact that it is a sparsely populated area. Although this was the case during Ramadan, during Hajj it is likely to be far noisier.

In the month of Shawal, during daylight, 19 sites 1, 2-14, 16-20 experienced noise between 74-80 decibels on average for five days and for the four geographical directions, with a highest average of 74-83 decibels for the five days. These measurements indicate that location 3 was subjected to noise levels between 80-83 decibels; 18, 79-82 decibels; 4 and 17, 78-80 decibels; 12-16, 77-80 decibels; 6 and 14, 76-79 decibels, 2, 5, 7 and 10, 75-79 decibels; and 1, 11 and 19, 74-78 decibels. During the same month, but in the evening between 17.00-20.00 and 22.00, 18 sites (1-14 and 16-20) experienced noise between 73-81 decibels on average for five days, for four geographical directions, with a highest average of 76-85 decibels for this time. These measurements indicate that sites 16 and 17 were subjected to noise ranging from 81-85 decibels; 4, 79-81 decibels; 12, 78-82 decibels; 18, 77-79 decibels; 2, 6, 11 and 13, 76-80 decibels; 5, 7, 14 and 20, 75-80 decibels; 1, 8, and 19, 74-78 decibels; and 10, 73-76 decibels. These positions were exposed to the most critical noise levels, even in Ramadan and Shawal, where the existing built-up area was seriously affected.

A comparison between the noise levels in Ramadan and Shawal shows that there are differences between the two months. The noise levels during daylight in Ramadan were less than in Shawal, because there was less traffic. From the results, it would appear that decibel levels due to traffic noise varied across the 20 locations surveyed. Spatial variation within the city was considerably less at night during normal times than during Ramadan. This relates to the variation in city population movement at significant seasons. The weekday spatial variations tends to be less than that at weekends. This is because more journeys are made by visitors and the city's inhabitants. Finally, it is to be expected that noise levels should be higher during Hajj compared with any other period of the year, since the influx of pilgrims causes increased traffic flow.

5.8.6 Noise: Conclusion

As the use of motor vehicles increases, so the problem of traffic noise worsens. Increase in car ownership has accompanied population expansion. The city network is one of the most heavily used among Saudi cities, due to numerous daily visitors and peaks at specific times, together with the daily movement of the population for various purposes (see Chapter 3).

According to the results of the survey carried out in connection with noise levels in 1986, it was not possible to establish a standard for Saudi cities. This being the case, noise level standards for traffic are compared with those abroad.

It has been found that the Federal Highway Administration (FHWA) of the United States recommended exterior noise level of 60-75 decibels and interior noise levels of 55 decibels [28].

Comparing the data about road traffic noise in Makkah with the standard abroad it has been found that the level at some survey sites was within the acceptable limits, while the level at others was above the standard recommended. Thus, the noise level may be categorised into acceptable and unacceptable. Thus, there should be legislation in the city to reduce the excessive noise produced in some areas by the traffic.

5.9 Air Pollution

Air is the cheapest resource available to mankind, and it is also considered the most valuable resource in the world [29]. During the last decade, that is, during the machine age, dependence on the use of petrol power, for instance in transportation and industry, as well as the use of atomic energy, has harmed the global atmosphere and polluted air that men breath. Air pollution is defined as:

> the presence in the atmosphere of substances or energy in such quantities and of such duration liable to cause harm to human, plant, or animal life, or damage to human-made materials and structures, or changes in the weather and climate, or interference with comfortable enjoyment of life or property or other human activities. (30)

The problem of air pollution has been the subject of much study and research, focused on pollution hazards as well as control. This is because pollution is showing clear signs of seriously affecting the earth's atmosphere, water, land and vegetation and also man. As reported by the United Nations, about 150 million tonnes of dust, gases and other pollutants are dispersed yearly into the air surrounding the earth [31]. In the last decade the human losses seriously increased due to air pollution. For instance, in the densely populated industrial valley of the Meuse, west of Liege in Belgium, a mist covered the whole country for three days in December 1930, and several thousand people suffered severly from pulmonary attacks and sixty died [32]. A similar disaster due to air pollution occurred in the area of Donora, Pensylvania, U.S.A. in October 1948 where seventy people died and the breathing of 6,000 was severely affected [33]. In London, the smog of December 1952 caused 4,000 deaths [34]. Moreover, in 1956, 400 people in New York, U.S.A. and 900 people in London died because of air pollution [35]. Also there were the accidents involving ionizing radiation at Three Mile Island, U.S.A. in 1979, and at Chernobyl in the Soviet Union, in 1986 [36]. From this, it is worth summarising the sources responsible for polluting the air, land, water and food on which we live. In summary, they are:

(1) Natural pollutants (mineral elements, vegetation elements, organisms and others);

(2) Pollutants from the fuel burning necessary for industry, transport and heating;

(3) Pollutants from industrial wastes;

(4) Pollutants from the burning or recycling of everyday rubbish, as well as the industrial wastes [37].

Generally, air pollution resulting from the combustion of any type of fuel is considered the worst environmental pollutant. Motor vehicles and other methods of transport using fuel are considered the main source, with motor vehicles emitting 60% of the poisonous gases which affect the pure air [38]. Transportation is a major contributor to emissions of carbon monoxide, hydrocarbons, oxides of nitrogen [39] and sulphur oxides [40].

It is apparent from the foregoing discussion that air pollution is a major and world wide problem. While motor vehicles contribute 60% of poisonous gases and cause air pollution. This section aims to show how air pollution in Makkah has been affected by the introduction of motor vehicles, which are increasing rapidly in number and in use.

The discussion on air pollution in Makkah caused by motor vehicles will not be based on all types of gases that motor vehicles produce. Carbon monoxide (CO) will be discussed, because we have to hand available data about the CO levels in Makkah which were measured by the author during fieldwork in May 1987.

5.10 Fieldwork

It was hoped by the author during the fieldwork conducted in 1986, to be able to measure the CO levels as one of the components of air pollution, while measuring noise levels in Makkah. Unfortunately it was not possible to do so, because of his short stay in the city. In 1987, the author had the opportunity to measure the CO that spread in the city atmosphere as a result of the heavy use of motor vehicles. The purpose of this was to obtain a general, if not clear, picture of CO levels and to ascertain whether it constitutes a health hazard to the peole of the city or on an international scale. The aim of this fieldwork was to make such data available where no data existed concerning the problem of motor vehicle pollution or of air pollution in general. Fortunately, the author has to hand published results concerning air pollution for some major cities in the Kingdom of Saudi Arabia. These cities are Jeddah, Riyadh and Dhahran, and also the proposed industrial areas of Jubail and Yanbu. Air pollution monitoring measurements were conducted in these cities during the period from 16 March 1977 to 1 April 1977. The data about these cities was found useful, and we will attempt to use part of it to run comparisons with our measurement results.

5.10.1 Survey Methods

In May 1987, ambient air pollution monitoring measurements (only of carbon monoxide) were conducted in several areas in the city of Makkah. The measurements were made on the major roads of the city which experience high volumes of traffic and congestion, such as roads penetrating the city centre, as well as those major roads leading to the city fringe and to major cities beyond.

The measurements of CO were made on the 28th of Ramadan 1407AH (26 May 1987), and the measurements were taken at six locations. These locations were:

(1) Abrahim Al-Khalil street penetrating one of the highly populated districts called Al-Missfalah;

(2) The main street penetrating Al-Haram area and passing the busiest area to the south west side of Al-Haram;

(3) The main street passing the north east side of Al-Haram;

(4) The main street penetrating Al-Aziziah district and leading to the city fringe and to major cities outside Makkah from the east;

(5) The main street penetrating Al-Utibiah district which is one of the highly populated areas; and

(6) The main street called Umm Al-Qura, leading to Jeddah and carrying the highest volume of traffic to Makkah.

Fifteen minutes was given to measure CO levels for each station. It was hoped to take measurements for one hour at each station, but difficulties which we will explain later caused us to minimise the time. The measurements were taken during the early morning between 05.30 and 08.15, with a total of about three hours, where half of this time was taken to conduct the measurement and the other half to move from one station to another. Measurements were also taken during the late evening, between 22.30 and 01.30. The reason for following this method was to establish the differences in CO levels between the time periods. The instrument used in the field to measure the CO was the CO 2,000 Carbon Monoxide Indicator, powered by a 9 volt disposable alkaline battery. The CO 2,000 is designed to indicate Carbon Monoxide concentrations in flue gas products. A flue gas sample is aspirated via the sampling assembly to the instrument, and the presence of CO concentrations in the range of 1-1999 parts per million are displayed on the digital display. Measurements of CO were taken at 150cm, which is recommended in the manual of the instrument. After allowing the instrument to warm up for 2-3 minutes, we check that the LCD (digital display) is on zero by using the Zero Control. Then we squeeze the aspirator bulb by hand, then release and allow the bulb to expand fully before squeezing again. Approximately 30 seconds, as recommended, was taken to aspirate a flue gas sample and the highest reading on the digital display was recorded.

Problems encountered while measuring CO levels were:

(1) the physical endeavour required to aspirate a flue gas, leading us to limit samples on six locations and to minimise time intervals;

(2) heavy traffic and congestion on roads, causing delay and interruption during the work; and

(3) lack of assistance, causing difficulty for the author in driving, looking for parking, operating the instrument and taking readings.

5.10.2 The Spatial Variation of CO Levels

Carbon monoxide concentration in the atmosphere of Makkah on the 28th of Ramadan 1407AH (26 May 1987AD) was found on average to be 30ppm/day (morning) and 53ppm/evening. Such results are not surprising where the high volume of traffic on most city streets and in particular streets in the city centre during the night time is common during Ramadan. Despite the fact that the measurements of CO levels taken by the author represent only one day during Ramadan, it is hoped to compare our survey results for Makkah with other cities in the Kingdom of Saudi Arabia and outside the country. The CO concentration in Makkah compared with a Middle East city in the coastal area of Egypt where it reaches 117ppm [41] is found to be low. The CO concentration in Makkah is found to be the same when compared with Saudi cities Riyadh and Jeddah, where CO exceeded 50ppm in 1977, when the two cities experienced high volumes of traffic [42].

The measurements of CO in Makkah showed that the concentrations of this gas in the city atmosphere vary between locations (see Table 5.9), and, at each location, from morning peak to evening peak.

Table 5.9 shows the highest recorded CO levels in area 2, on the street passing the south west side of Al-Haram, this being due to the high level of traffic passing this area carrying people mainly intending to visit Al-Haram, day and night. It is not surprising to find such a result, where CO levels show a distinct diurnal pattern with peaks corresponding to the morning and evening traffic rush hours [43]. It was observed, while measuring CO levels in area 2, that another factor contributed to raising CO levels in this area, which was traffic congestion where vehicle speeds varied between 0-15km per hour.

Table 5.9 Average carbon monoxide level in Makkah (ppm*)

Station:		CO Levels (ppm*):	
Number	Location	Evening	Morning
1	Abrahim Al-Khalil Street	51	21
2	South west of Al-Haram	109	88
3	North east of Al-Haram	56	40
4	Al-Aziziah Street	8	5
5	Al-Ulibiah Street	43	19
6	Al-Seteen Street (Now Umm Al-Qura)	52	7

Source: Fieldwork, 26 May 1987, Makkah, Suadi Arabia

* ppm = parts per million

It is evident, as observed by traffic engineers, that there is a relationship between vehicle speed and CO level. The CO emission is high when the engine is running but the car is not in motion, As the car sets off and runs at various speeds, the CO emission level changes [44]. Generally, the concentration of CO in areas 3, north east of Al-Haram; 1, on Abrahim Al-Khalil street; and 5, on Al-Utibiah street, is lower than that in area 2, but still high. The concentration of CO in these areas is due to the same factors as those influencing the CO concentration in area 2, south west of Al-Haram. The concentration of CO in area 4 was found to be very low, due to the high speed of motor vehicles on that street, CO concentration decreases as the motor vehicle speed increases. The same was result obtained in area 6 on Umm Al-Qura street during the morning peak, because of the low density of traffic and free flow, while the CO levels on the same street during the evening peak were high, as in areas 1, 3 and 5.

Generally speaking, it can be said that Makkah has been associated with the problem of motor vehicle pollution at its most severe. This is because the city and its built-up area is bound on most sides by mountains (Plate 5.3) which block the passage of polluted air from the metropolitan area specifically where the valley of Makkah becomes extremely narrow, i.e. the city centre, where the valley measures about 800 metres. There are geographical similarities between the local relief of Makkah and that of Los Angeles County, which is bound on two sides by mountains, thus blocking the passage of polluted air [46].

5.10.3 Air Pollution: Conclusion

As the use of motor vehicles increases (see Chapter 3), which results in excessive noise (see previous section on noise), it also results in the emission of considerable amounts of gases to the city atmosphere that can create serious health hazards for the city population, as well as for plants and the city environment as a whole.

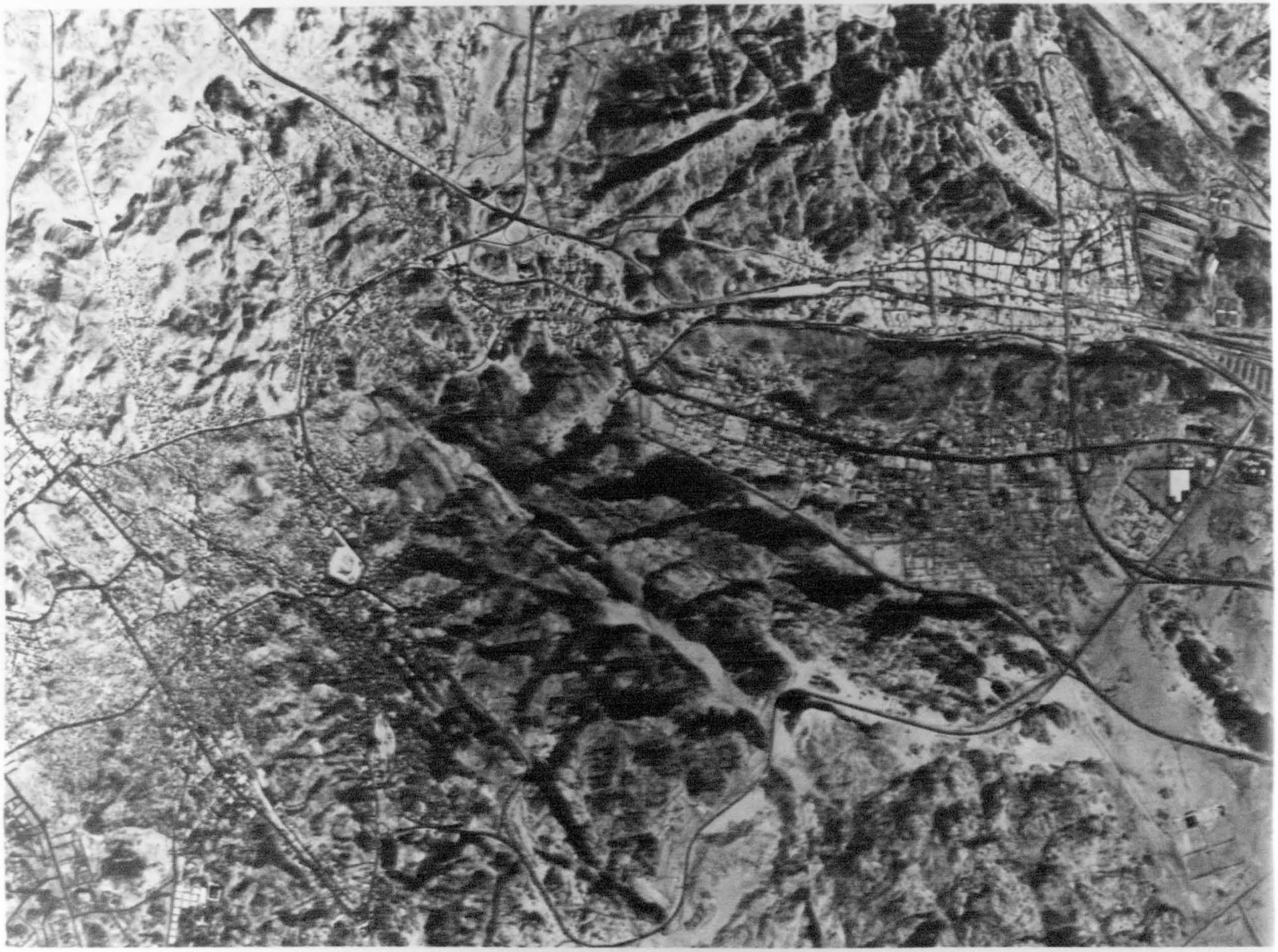


Plate 5.3 Natural features in the Makkah city region inhibit the easy flow of traffic and induce atmospheric pollution by carbon monoxide.
Source: Bodo Rasch, Mahmood, 1980, The Tent City. Hajj Research Centre, Jeddah, Saudi Arabia

According to the results of the survey to measure the CO levels on 26 May 1987, it was found that CO concentrations on roads in the city centre and on other major roads in the city were in excess of 50ppm. Their values are greater than the maximum allowable 1-hour average United States standard of 35ppm (46). Therefore, great attention should be paid to the problem of air pollution in Makkah, and practical steps should be taken to reduce air pollution in general and the CO level in particular. These pollutants are mainly the result of excessive motor vehicle use, especially on the city centre roads and those roads serving important centres. CO levels must be reduced , as well as levels of other gases produced by motor vehicles, because:

> Carbon Monoxide is very poisonous in high concentration, and even at low concentration it can impair mental ability and could lead to road accidents if peoples' alertness was reduced (47).

5.11 Recommendation

The following recommendations are made in order to reduce road accidents in Makkah:

1 The school curriculum should include teaching about all aspects of road safety at each stage in a child's school career.

2 Books on road safety should be readily available to motorists and the general public in order to make them aware of the causes of accidents and their avoidance.

3 The city municipality should create play areas for children

in order to keep them out of danger.

4 The city municipality and the Traffic Department should combine to create zebra crossings so that pedestrians may cross the road in safety in congested areas.

5 The media should educate and involve the population in the reduction of road accidents.

Two points are recommended in order to reduce congestion on city streets:

1 The public should be encouraged to use buses. This could be achieved by reducing the fares and increasing the frequency of the buses.

2 Working hours could be reorganised in order to alleviate congestion. For example, students would go to their schools at 07.00; employers would go to work at 07.30; and workers travel last. This would stagger travelling and hopefully achieve a smoother flow of traffic.

Concerning the reduction of road traffic noise in Makkah, the author makes the following suggestions:

1 Parking along city streets should be limited to less congested areas, thereby reducing the noise of cars constantly stopping and starting due to traffic jams.

2 Motorists should keep their vehicles well serviced and drive in a considerate manner.

3 Drivers should only use their horns when absolutely necessary.

4 Where there is excessive noise in residential areas, there must be adequate insulation, bearing in mind the fact that temperatures can rise to more than 40^{o}C in summer.

Concerning the reduction of Carbon Monoxide levels produced by motor vehicles, as well as other gases which may be no less dangerous, the author makes the following suggestions:

1 Traffic to the city centre, especially that heading for the Al-Haram area, should, if not must, be restrained where this can help reduce the dangers of the CO, which is found in a level exceeding the maximum acceptable standard, even nationally or internationally.

2 Parking along city streets should be limited to less congested areas, thereby reducing the air pollution caused by motor vehicles constantly stopping and starting due to traffic jams.

3 Car parking should be removed from the city centre to open places outside the city centre, where the air circulation can dilute and disperse the pollutants at or near their source, and prevent high local concentrations.

4 Every car used in the city must be subjected to a regular mechanical check.

5 Trees should be planted to reduce the effect of polluted air on humans. This is because the critical oxygen balance of the global atmosphere depends on the contribution of trees during the photosynthetic process [48].

6 The public should be encouraged to use the buses.

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CHAPTER 6

PARKING DEMAND AND PROBLEMS IN MAKKAH

6.1 Background to Parking Demand and Problems in Makkah

The purpose of this study is to consider, in adequate perspective and as much as possible, aspects of Makkah's urban parking problem. The object has been to provide valid data and ideas about parking problems. It is recognised that the parking problem in Makkah has both immediate and long-range aspects, but that there are few means of solving the problem. It has been developing since the advent of motor vehicles and has become increasingly more apparent.

Unless parking facilities are provided, people will be discouraged from participating in activities which, in turn, may affect the economy of the city. The improvement of parking provision would relieve traffic congestion and related problems. The location and access of parking spaces can greatly affect traffic flow. Parking spaces in the city must be balanced against local demand and the capacity of the city network. Therefore, the parking problem deserves independent consideration. Naturally, the question arises as to the predominant factors causing a severe parking problem in a developing city like Makkah. Thus, an attempt will be made to discuss some of the issues which contribute most to the worsening of the situation in the city.

The physical factors (see Chapter 1) in Makkah influence the severity of the parking problem. Mountains, as one of the relief features in the city, are very complex in their distribution and also limit the area of flat land available for parking. This flat ground also has to meet other human requirements for housing, shops, schools, hospitals etc. Thus, there is competition for the use of available ground. In addition, the central area is limited in size with its boundaries fixed by previously established land use and by the location of the Makkah Valley which is no more than 1km in width. Also, great numbers of tall buildings have been built around the central area (Plate 6.1), due to the importance of Al-Haram. Landlords owning property in the vicinity of Al-Haram are able to charge high rents during and outside the period of Hajj. There is insufficient parking space near these buildings, which aggravates the problem.

Another factor which plays a significant role in further exacerbating the situation is the weather conditions. The high temperature of 48°C [1] in the summer season, for instance, causes people to look for the shade of buildings near their destination and if there is none available, they try to park as close as possible to that destination, thereby avoiding the heat. This method of parking results in the disorganised accumulation of vehicles which affects the street's capacity and creates congestion and delay for the traffic flow.

Women also play a role in putting pressure on parking spaces in the city, such as shopping areas and other centres where they wish to go. This is because there is an increase in two-car families (see Chapter 3), enabling the wife to go shopping

Plate 6.1 View of Al-Haram in 1986 showing tall building and rocky hills which limit the potential for vehicle parking, and the survival of narrow streets.

Source: Hajj Research Centre, Jeddah, Saudi Arabia 1986 whenever she wishes, providing there is a chauffeur or son available to drive the car. As a result, parking and traffic demands may be higher, but more evenly spread. A conflict arises between, for example, shoppers who wish to park and residents who may be competing for the same spaces.

Delivery vehicles stop by the road immediately outside the shops, there being no specific unloading bay, often occupying enough space for three cars. Customers frequently need to use their cars to collect goods which they have purchased. In addition, shoppers and workers also need to park their vehicles. The streets in the shopping area are therefore very congested throughout the day.

The absence of white lines to define parking spaces makes the problem worse. As yet, there are no parking meters, so motorists can leave their cars for as long as they wish, thereby forcing other drivers to double park, drastically affecting the traffic flow.

With inceased activity and mobility, people in Makkah go largely when and where they wish; most frequently where travel facilities best meet their needs and convenience. It is obvious that the main function of streets is to facilitate the efficient movement of vehicles and pedestrians. Previously, the streets were narrow and limited and were thus unable to meet traffic demand. During recent years the city network has been improved to a great extent to cater for the increase in traffic volume, which is due to greater car ownership and an expanding population. However, this improvement has been counteracted by the inadequacy of parking facilities. Traffic flow is adversely affected by the dominance of on-street parking.

In 1971, the traffic survey carried out by the consultant, Robert Matthew, showed that there was an acute car parking problem in the city centre. To satisfy the demand for parking in this area, the consultant made some recommendations. One of these was to create surface level car parks which require 37 hectares for low population (550,000) in 1991 and 51 hectares for high population (950,000) in 1991. The other suggestion was the establishment of multi-storey car parks. As mentioned previously, boundaries and size of the city centre are limited, so it would not be practical to locate surface car parks within the heart of the city. The city authority has adopted the latter recommendation by building a multi-storey car park where parking was very limited and needed rapid action to improve the situation. However, the consultant did not take into consideration the parking problem of the city as a whole, being the most clear phenomenon needing policy relief.

In Makkah, motorists attempt to park in every vacant on-street space. In two-way streets, they usually occupy one lane in each direction. This has a negative effect on the city network by reducing its effectiveness and capacity. Here again, the question arises as to why streets in Makkah are used so extensively for car parking? The answer is that houses in Makkah have no garages, so streets are used instead. In addition, people in Makkah have no choice because there is no access to their houses. This usually creates obstruction for traffic flow, resulting in congestion and delay. Double and blocking parking is often observed at most major traffic junctions. It is necessary to find an alternative in order to end this ever increasing problem. Another negative side of using both sides of streets for parking involves manoeuvring into and out of the spaces, creating hazards.

> Directional movement of parking and unparking cars is practically at a right angle to traffic in the moving lanes. Studies show that accidents involving parking or parked cars account for approximately one-tenth of all accidents, and half of those involve parked cars. The next highest percentage of parking accidents involves cars moving from the kerb. Cars slowing to park, double-parked, and backing into kerb spaces account for most other parking accidents.
>
> More accidents result from angled than from parallel parking. In leaving the angled space, the driver is required to manoeuvre blindly into the traffic stream, often causing moving cars to swerve, inducing collisions with opposing traffic.
>
> Kerb parking too near an intersection creates traffic accidents. The parked car contributes to fatal pedestrian accidents. Regularly, eight to ten percent of the pedestrian fatalities involve persons entering the roadway from behind or between parked cars. Approximately the same percentage of pedestrian injury-accidents occur under these conditions (2).

Parked cars on the streets in Makkah also create a great obstacle for the emergency vehicles such as those of the police and fire brigade. It has been observed that the lack of parking spaces compels drivers to park their cars on both sides of the streets, preventing access to the place of the accident.

The central aim of this section is to evaluate the problem of parking within Makkah, with considerable emphasis on the problems at hospitals, which will be discussed in Chapter 7. Problems of government offices, residential areas and the Haram area will be discussed in subsequent sections.

6.2 The Importance of Al-Haram and the Demand for Parking

> In any city, the parking problem makes its first appearance in the central business district when the kerb is no longer able to accommodate parking demand. Most drivers would prefer to park at the kerb if spaces were available.
>
> A shortage of parking space in the central business district not only creates parking congestion of its own, but available kerb space creates competition and contributes heavily to traffic congestion. At the same time divergent interests may conflict. Shoppers, workers and many of the merchants have direct interest in kerb parking; transit operators, fleet owners, highway officials and others are primarily intersted in expediting traffic (3).

From the foregoing, it is evident that this concept of the central business district is not applicable to Makkah. This is because the centre of the city is Al-Haram (the main mosque) which has its own function as a very important religious centre where the Kaaba (the house of Allah toward which people turn their faces five times a day in their daily prayer and make Twaf around it) is located in the middle of Al-Haram. The Haram is the heart, soul and direction for Muslims in the city and throughout the country. Major roads radiate from the Haram area and it is the heart of the traffic and parking congestion. More people are affected by parking conditions here than in any other region. Due to its importance, the Haram is the focal point of the residential and commercial (Suk) areas. For this reason also, Muslims come to Al-Haram from far and near, visiting it at least once in their life. Thus, the Haram forms the dominant factor and focus of all trips having religious significance throughout the year and continuously, 24 hours a day. The movement to Al-Haram is not constant as it is usually higher at prayer time, returning to normal after prayer. Also, the movement to Al-Haram varies throughout the week, being average during weekdays and increasing at weekends, especially Thursday evening and Friday afternoon for Friday prayer. In addition, the number of those going there varies by month and season. The greatest movement occurs usually during Hajj, and to a lesser extent in the months of Rajab, Shaaban and Ramadan.

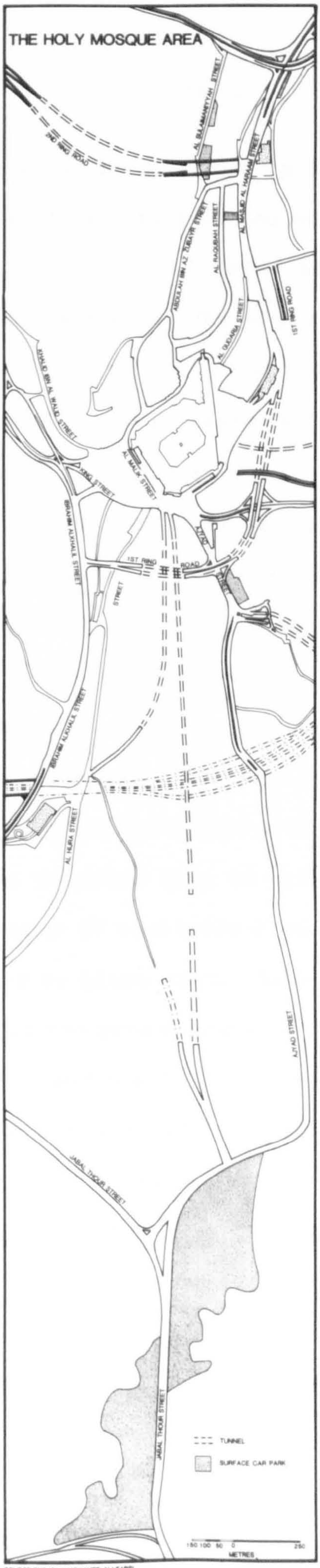
The modern road network that links Saudi Arabian cities and neighbouring countries encourages people to travel by car to Makkah and to visit Al-Haram during the months mentioned above and during holidays. The resulting influx of traffic keeps the Al-Haram area very busy. Additionally, improvements have been made to the city network by creating ring roads and tunnels, resulting in easier access to Al-Haram by city inhabitants, at the same time increasing traffic volume. Al-Haram is thus affected by the movement of city dwellers (internal movement) and by that of visitors (external movement). Since the majority drive to Al-Haram and there is an acute shortage of parking space, parked cars adversely influence traffic flow in the area.

6.2.1 The Demand for Parking in the Al-Haram Area

In Ramadan 1986, more than 300,000 vehicles entered the city to transport visitors and those performing Ummra [4]. Thus, the daily average was 10,000 vehicles. This number of cars exceeds the open area around Al-Haram and creates a high demand for parking spaces for visitors, since the available area is very limited (Fig. 6.1). The situation is exacerbated due to vehicles of the city people who come to Al-Haram every day throughout the year. In addition, those travelling to the commercial area next to Al-Haram (to the north) also create pressure on the available parking spaces in Al-Haram area. Drivers compete to occupy every available space which becomes vacant. A further problem is caused by those working in the commercial area, such as merchants, bank employees and government employees, who travel by car and occupy places for long periods during the day. Great demand for parking spaces in Al-Haram area is unavoidable, pending a solution.

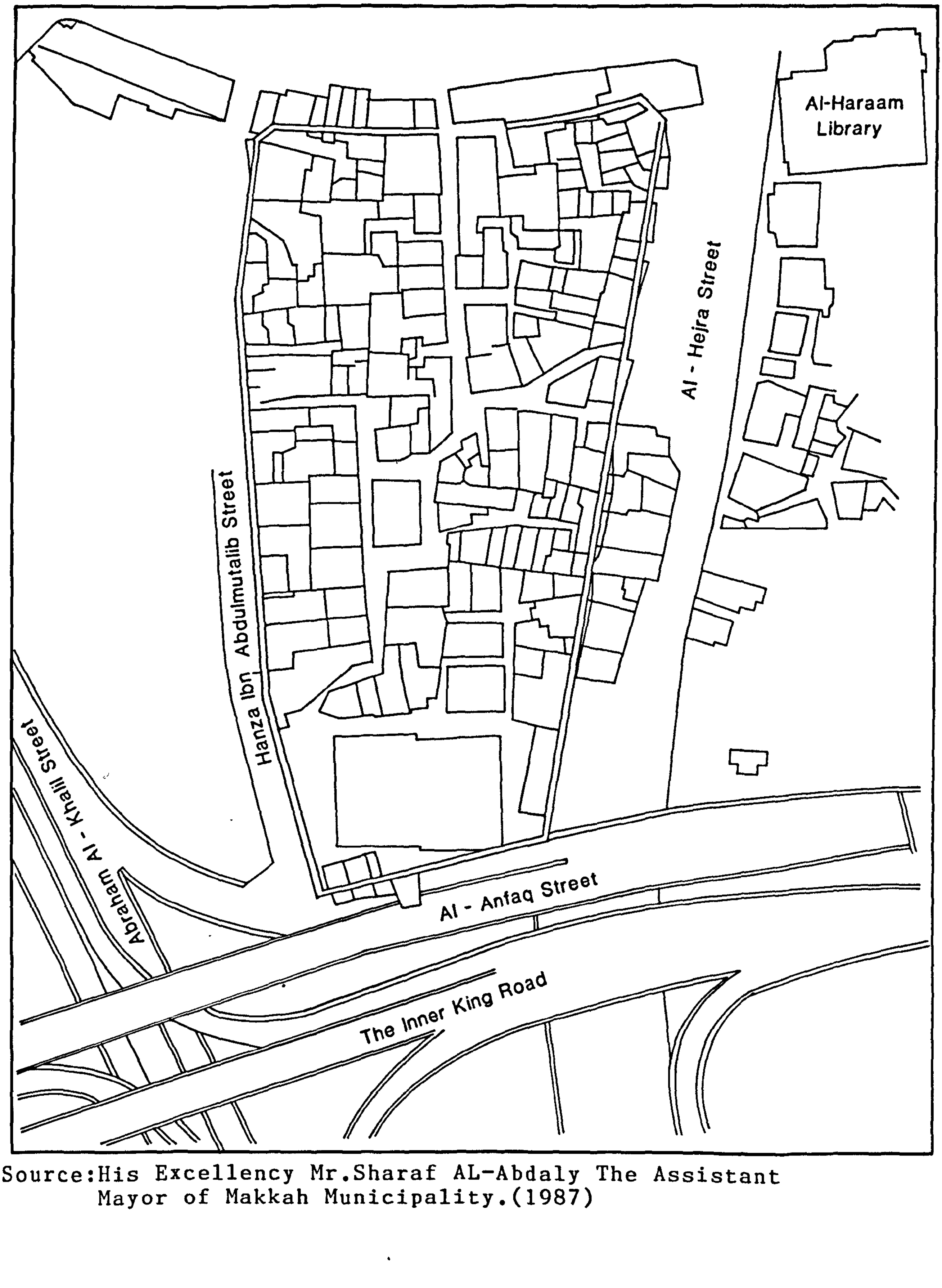
From the foregoing, it can be seen that the Al-Haram area requires two types of car parking in order to meet demand. One is short-term for those who come to pray at Al-Haram and those who travel to the commercial area next to it. The other is long-term for those who work in the central area and need to park for a long period of time. Providing parking spaces for those working in the city centre is a very important matter for the revival of the area. The commercial area provides vital services for inhabitants and visitors.

Fig.6.1
The Open Air Car Parks In AL-Haram Area.



At present, it would be difficult to create such car parks, since there are several factors limiting space. One of these is the intensive land use in the Al-Haram area, making car park spaces very few (see Plate 6.1). The high land value in Al-Haram and the high rental on buildings occupying every single space, accommodating inhabitants and pilgrims during Hajj, and visitors at other times, result in high revenue. The practice of having buildings around Al-Haram area touching each other deprives the area of benefitting from off-street parking (Fig. 6.2). Mountains around Al-Haram limit the area of flat land which is already extensively built on, decreasing it further. Parking at Al-Haram by the kerb is often lengthy due to the absence of parking meters. These factors all play a role in keeping spaces very limited and frustrating drivers who wish to park close to Al-Haram. Motorists therefore have to drive round in search of spaces. In the absence of available places, the driver has no choice but to double or block park. Searching for a space is less of a problem for the person who lives in the city, because he knows where, when and how to find one near Al-Haram. The problem is acute for visitors who come to the city and have no knowledge of where to park their cars. Thus, they contribute to the congestion around Al-Haram since they have to drive round in search of parking spaces. Once visitors become tired and frustrated after an unsuccessful search, they often park illegally, running the risk of being fined, but being determined to visit Al-Haram. Illegal parking takes various forms such as

Fig.6.2 Form Of Land-Use



Source:His Excellency Mr.Sharaf AL-Abdaly The Assistant Mayor of Makkah Municipality.(1987)

double, blocking or angled parking. The shortage of parking spaces around Al-Haram leads people to park their cars inside tunnels and on bridges leading to Al-Haram (Plates 6.2 and 6.3).

Cars parked on the wrong side of the streets around Al-Haram or streets near to it, creating congestion and impeding traffic flow, are towed away and owners are fined. When the writer was in Riyadh collecting data for this research, it was by coincidence that he met a taxi driver in 1986 who conveyed him from where he was staying in Al-Dhabab street to the Ministry of Transport. He recounted the problems he had encountered when attempting to park near Al-Haram:

> When it was the school holiday, between the two terms in 1405 AH (1986 AD) I took my family to visit Makkah and perform Ummrah (little Hajj). Once I arrived in the city area, my desired destination was the Al-Haram area. As soon as I arrived there I went to the multi-storey car park, after asking one of the inhabitants for directions, because there are no signs on the route around Al-Haram to indicate its location. Finally, having arrived at the car park, I found its entrance closed because it was full and I was advised to go to the other car park, which was further away. It was very difficult to reach the location of that car park too, because of the absence of signs. Unfortunately, that car park was also full. I then decided to return to the Al-Haram area to search for kerb space to park my car. I spent more than 40 minutes searching for a space without success. After becoming tired and not knowing of an alternative place, I decided to park anywhere around Al-Haram, at my own risk. When I did this, a policeman on a motorcycle told me that I should not have followed the double parking method and that unless I moved my car, it would be towed away. In addition to that, the traffic police were going to issue a fine for illegal parking and a fee for storage of the car. I was in a dilemma as to whether to take the risk and park illegally or find another solution. Finally, I decided to go to the city outskirts to park and took a taxi to Al-Haram. This avoided the possibility of my car being towed away and saved time and money (5).

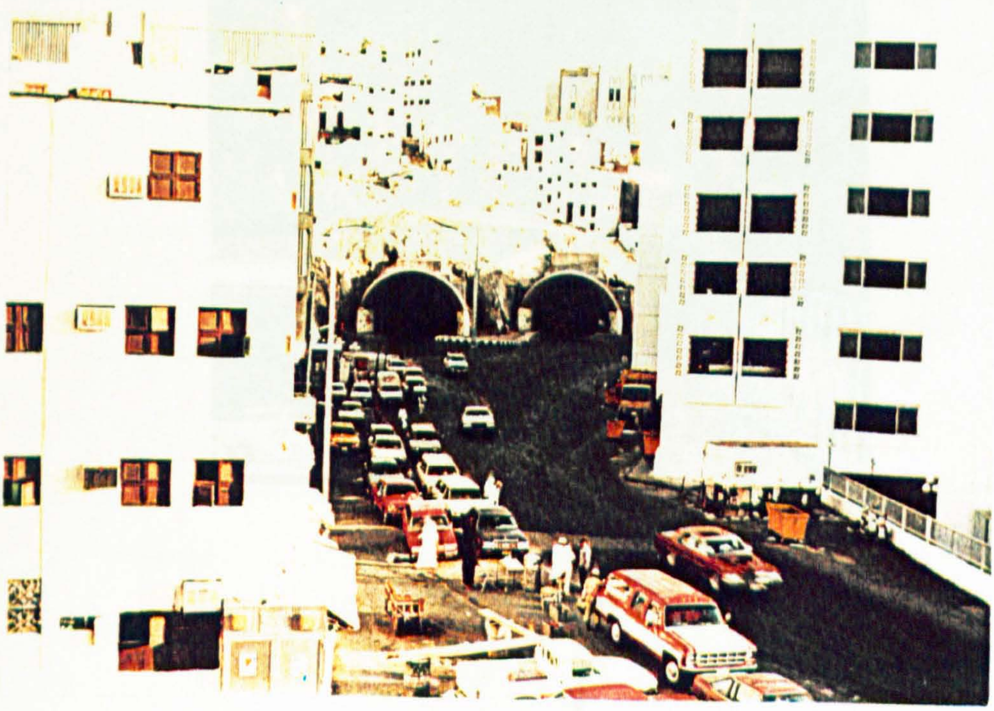


Plate 6.2 Parked vehicles at the approaches to Al Missfalah tunnel (top) and the Inner Ring Road tunnel (bottom) in 1986. (Photo: Z.A. Mekki, 1986.)

Plate 6.3 Illegal parking on bridges in Makkah; near Jihad hospital (top) and at Shubikah bridge (bottom) in 1986. (Photo: Z.A. Mekki, 1986.)

That story of a taxi driver from Riyadh who visited the city and encountered parking problems is typical of the experience suffered by many visitors.

The parking demand around Al-Haram is not just today's problem, but is many years old and yet still exists. To satisfy the demand for parking in the Al-Haram area is the usual point of discussion of city people and writers of the daily newspaper. In Al-Nadwa Daily Newspaper, an article was published under the title of: **The Visitors of Al-Haram and Their Difficulty Which We Hope Will Be Diminished (1985).**

The writer of this article cited:

> Visitors to Al-Haram have been suffering from the shortage of car parking spaces in the al-Haram area and many cars are towed away to release streets of Al-Haram area and streets around it of the influx of traffic. So the problem of visitors to Al-Haram still exists, because of the shortage of car parking spaces. Nobody realises this problem, except those who come from outside the city of Makkah. The person who comes to the city does not know where to park his car or even where to go. Moreover, the policeman forces him to move his car to another place. Difficulty arises when the car owner and his family go round and round, searching for a vacant space, eventually becoming very tired after driving for a long time (6).

From the foregoing, it is obvious that there is a very great demand for parking spaces in the Al-Haram area, the shortage of which creates a very serious problem for motorists and requires an immediate solution.

6.2.2 The Planning Policy and Response

The increase of private vehicle ownership and usage will result in increasing pressures to control the use of road space and the conflict between moving traffic and stationary vehicles will be acute in the city centre, commercial areas and other busy regions of the city. Consequently, the main car parking policies must aim to provide a balance between the capacities of the car parks and the road system to serve the central area and other centres adequately.

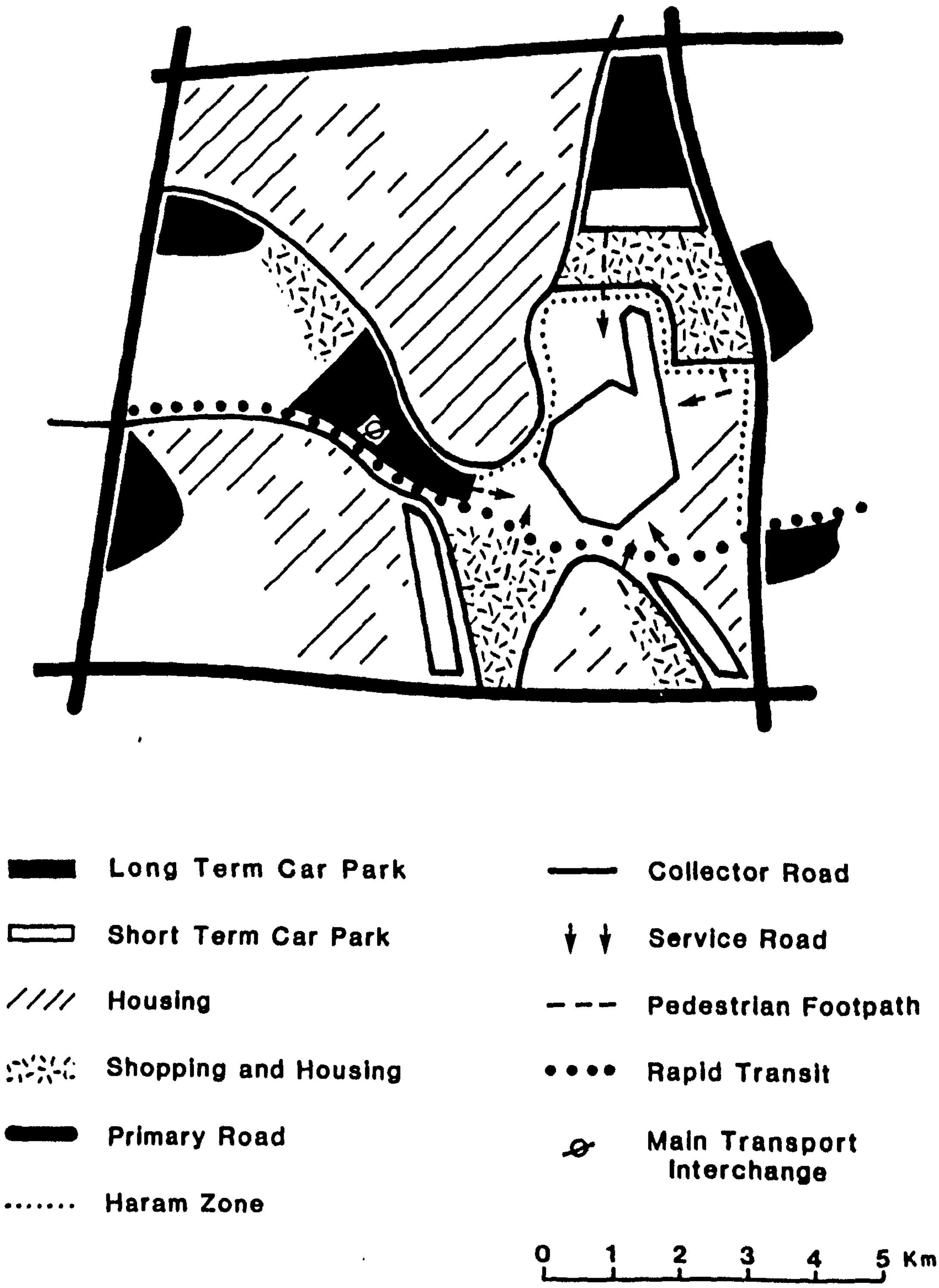
The city planners had already responded to the problem. One of the city planners in the '70s was the consultant Robert Matthew, who suggested some policies for adoption in the central area. The planner divided the demand for parking into two categories. The first, short-term parking related to shopping and business trips. The second, long-term parking, mainly for workers employed in the central area. As shoppers and business callers are essential to the economic prosperity of the commercial centre, priority should be given to accommodating these parking demands in convenient sites within or close to the central business area. However, whilst long-term parking facilities could be located on more peripheral sites, such car parks should provide reasonable access to the centre and walking distance should, whenever possible, be less than 400 metres. The general locational policies for car parks must be related to proposed road access and land availability in the central business area. Further, any proposals to accommodate vehicles in off-street surface car parks must be examined, not only in terms of the availability of land, but also the merits of developing multi-storey car parking and thereby releasing valuable land for commercial developments. The consultant also made a proposal concerning the central area. This was to keep the ground floor of buildings around Al-Haram as open areas which could be used by pilgrims for parking during Hajj.

The traffic survey carried out by the consultant in 1971 indicated that 500 private vehicles terminated trips in the central area during the morning peak period. He predicted that by the year 1991, the central area would attract 12,800 private cars in the case where there was a low population density (550,000) and 18,500 private vehicles where there was a high population density (950,000).

The consultant's plan took into account the local pattern of shopping and business trips, a large proportion of which occur in the evening. As the consultant analysed purposes of trips to the city centre, he discovered that the duration of parking for shopping and business was on average about one hour and the average parking duration for work trips about six hours. Based on these results, the consultant recommended creating 10,000 long-term and 3,000 short-term parking spaces for the low density population, and he proposed 15,000 long-term and 3,000 short-term parking spaces for the high density population. To accommodate these parking demands in surface level car parks would require 37 hectares for the low density population and 51 hectares for the high density population. The consultant concluded that it would not be practical to locate such surface car parks within the proposed commercial area. Consequently, Fig. 6.3 shows the principles of the recommended location policy for parking in Makkah within the central area. The short-term car parks were located close to the shopping and commercial areas, and the long-term car parks were sited in peripheral regions to the north, west and east of the centre. In order to meet the parking demands of the high density population it would be necessary to pursue a policy of progressive development from surface parking to multi-storey car parks (7).

From the foregoing, it would appear that the consultant considered only the city population and the commercial area when making his recommendation. He did not make any suggestions concerning Al-Haram and the great demand for parking made by its visitors. Referring to the number mentioned previously for cars entering the city during the month of Ramadan, it can be estimated that 10,000 spaces are required to satisfy the demand for parking by visitors. In addition to that, extra spaces are needed for those coming to Al-Haram every day for daily prayer. Unfortunately, data are not available for this latter number. Those who come to collect a container of Zam Zam water, for its significance, also travel by car. From all these figures, it can be estimated that 26 hectares are needed in the form of surface car parking around Al-Haram in order to satisfy the demand for

The recommended locational policy for parking in Makkah



SOURCE: Western Region Plan (Makkah)
Ministry of Interior, Municipal Affairs Regional and Town Planning Department

Fig.6.3

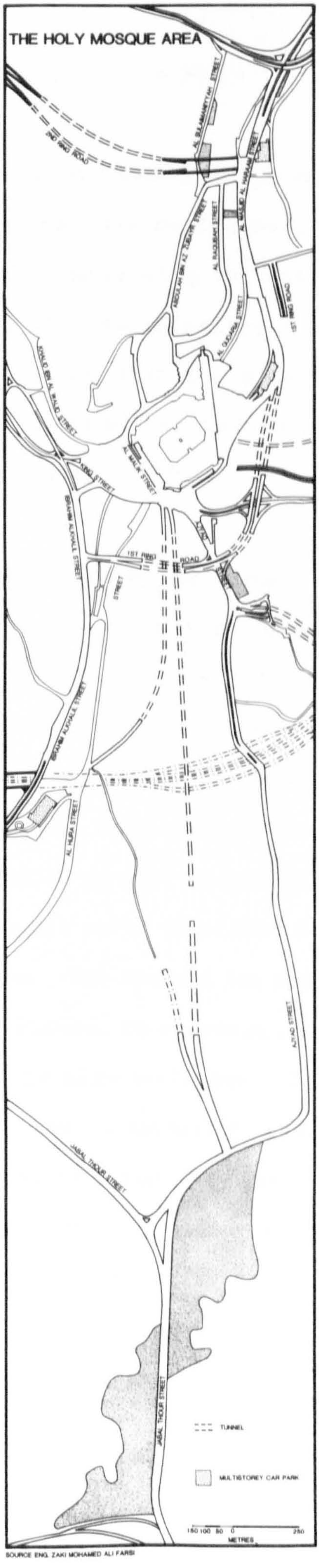
parking outside the period of Hajj. It would be difficult to provide such a surface car parking area because the region around Al-Haram is very limited. This is due to the intensive land use and the complex hills which keep the area restricted. Demolishing houses around Al-Haram to create such an area for parking spaces would not provide the solution since, by doing so, the accommodation required for pilgrims would be removed. Also, the level of compensation required by owners would be too high, rendering the project uneconomic. Besides causing a housing shortage, the demolition of houses would destroy the community. However, car parks are still required to meet increasing demand. Multi-storey car parks must be the solution, although some demolition would still be necessary. Ten multi-storey car parks are required for 10,000 vehicles, which would meet demand for the Al-Haram area.

6.2.3 Multi-Storey Car Park Construction

The city centre of Makkah was built up long before the car became a popular and important factor in transportation. This central area has inherited a street system incapable of handling traffic. However, the city planners realised that these streets should be expanded and improved to meet the ever increasing demand. The new road systems in fact bring more traffic to the city centre, increasing the serious demand for parking spaces. Constructing car parks will help to absorb the traffic flow and reduce congestion. To this end, the city Municipality constructed three multi-storey car parks in various areas of the city in response to the parking problems. Fig. 6.4 shows the locations of these car parks.

One of the multi-storey car parks is at Al-Qushashiah and is located about 150 metres from the east side of Al-Haram. It has capacity for 650 vehicles and is heavily used by motorists. The use of this car park varies according to the season of the year. During the period of Hajj, it becomes full all day, every day and the duration of parking is longer than at any other season. The cost of parking is two Saudi Riyals per hour, for the first three hours. After that time, the cost is increased to five Saudi Riyals per hour. A subscription to this car park costs 800 Saudi Riyals per month. Another multi-storey car park is situated at Amir Path, north of Al-Haram and located on Al-Masjid Al-Haram street. The distance between this car park and Al-Haram is approximately 950 metres. It is not as popular as Al-Qushashiah car park since it is further from Al-Haram. Thus, motorists use Amir Path car park when the other car park is full. This latter caters for 450 vehicles and costs one Saudi Riyal per hour for the first 12 hours, after which time the cost is two Riyals per hour (8). A third multi-storey car park is Al-Missfalah, which is located south of Al-Haram on Ibrahim Al-Khalil street. The distance between this car park and Al-Haram is about 1.8km. Although its capacity is 400 vehicles, it is not in use at present. It is located too far from the centre to attract

Fig.6.4
Location of the
Multi-Story Car
Parks.



SOURCE ENG. ZAKI MOHAMED ALI FARSI

motorists and there is no connecting bus service. This car park is only used for a few days during Hajj by residents of Al-Missfalah, since kerb-side parking is forbidden on Ibrahim Al-Khalil street. The city Municipality plans to build a multi-storey car park in Jiyad district with a capacity of 2,000 vehicles [9]. A multi-storey car park is also planned for Jabal Hindi in Al-Shamiah district [10].

6.3 Evaluation of Multi-Storey Car Parks

It is essential to evaluate this type of car park since they are an innovation among people are familiar with kerb-side parking. The purpose of this evaluation is to measure the current parking habits and demand of people using this new type of car park. This section takes into consideration an assessment of access to the location as well as access by people using them. Also, trips to these car parks are taken into consideration as well as their origins. The reasons for which motorists use the car parks are also studied, to ascertain the dominant purpose. Duration of parking is also evaluated. Problems facing users must be analysed in order to establish general requirements. No data has been published to assist this evaluation and therefore a survey was designed in order to obtain the necessary information. No recommendation can be made without relevant data.

6.3.1 Field Survey Method

The purposes of this survey were to discover whether the multi-storey car parks which already exist meet demand in the Al-Haram area, and to identify the peak times throughout the day and the week, as well as normal demand. The survey will also endeavour to discover the effect of on-street parking round the Al-Haram area when the car parks are full.

First of all, there was a meeting with the director of the car parks, in order to give him a brief explanation about the purpose of the survey. The intention was also to obtain his personal point of view, gained from direct experience while managing these car parks. It was necessary to arrange distribution of survey samples and to seek the director's advice and assistance in dealing with any problems.

Through observation, it was possible to note problems of access to car parks or exit and absorption into traffic flow. Through driving our own car into the car parks from various directions, we could experience any problems associated with location first hand.

The time of each interview was estimated to be 5-10 minutes and every third driver was questioned on approaching the exit. Drivers were interviewed before paying the cashier. Notice of the survey was given in order to gain the co-operation of the car park users. Interviews were carried out on the ground floor.

The time selected for distributing the survey samples was between 06.30 and 20.00 hours. By conducting the survey over this time span, variation in demand could be noted; also the opinion of different car park users, throughout the day. The survey was conducted over 12 days in June 1985 and problems encountered are discussed below.

Details requested were car capacity, origin and distance of journey, duration of parking and purpose of using the car park. Reasons for using the car park were grouped into shopping, work and others (to be specified by the interviewee). Drivers were asked about any problems encountered when using the car park. They were also questioned about destination and reason for going there. This was asked to ascertain whether motorists came only from inside the city or from both outside and inside.

1,200 samples of the survey were distributed to drivers and these were divided equally between the two operational car parks (Al-Missfalah was not in use). 800 samples were returned, of which 584 were valid and complete and upon which the analysis was based. The invalid results were excluded because they were incomplete and had not been answered seriously.

The survey encountered several problems. The small team size precluded a simultaneous count of cars entering (inbound) and leaving (outbound). Families are not allowed in the car parks, for security reasons. Some motorists were unwilling to co-operate as they were short of time for collecting their family outside the car park. As the survey only lasted 12 days, it was not possible to analyse weekly variation of demand.

The discussion of the field survey results will follow the disussion on access to the existing car parks.

6.3.2 Vehicular Access to Car Parks and Pedestrian Exits

> A site between the central business district and expressway approach facilities is highly desirable, since it makes access to the car park easy and also helps keep traffic off congested streets (11).

From the foregoing it will be realised that the location of the car parks in relation to source of traffic is significant in contributing to easy access. The discussion concerning access of vehicles to the multi-storey car parks in the city will be on the two car parks in use at present. It will be based on direct field observation, made in 1985. The field work was carried out during and outside the month of Ramadan in order to identify the variation of access to these car parks at different times of the year. In addition, the access to each car park will be discussed separately.

Al-Qushashiah car park is located to the east of Al-Haram and exactly at the gathering points of streets carrying traffic leaving outside the Haram area. This makes car park access difficult, since any driver using that car park must travel on busy streets, thereby lengthening journey time. There is some difficulty over access to the entrance of this car park because it is located at a junction (see Fig. 6.4). This siting creates conflict between vehicles turning into the car park and those turning into the adjacent street (see Plate 6.4). Additionally, leaving this car park and joining the traffic flow is not easy, since the exit is in a very busy and congested street (see Plate 6.5), where the driver must pay great attention to traffic passing in both directions. Also, the motorist leaving the car park has to manoeuvre to join two traffic flows, which may lead to accidents. It can therefore be concluded that the location of this car park is unsatisfactory. This car park should have been built where roads converge leading to Al-Haram, which would reduce traffic in this area. We consider that difficulties over access will limit patronage and encourage street parking.

The Amir Path car park is also surrounded with difficulties concerning access, since only one street leads to its location. Another problem arises over the confusion which occurs in connection with reaching the entrance. There are no signs to indicate its location on a secondary street off Al-Haram street. On leaving the car park, the driver must pay attention to joining the traffic flow from the left hand side and to vehicles coming to the car park from the adjacent street (see Plate 6.6 and 6.7). Another hazard is pedestrians who walk out of both car parks to go where they wish. The car parks should be located close to major centres so that people do not have to pass through areas they do not wish to visit [12].

When evaluating the sites of the car parks in the city, it can be said that the location of Al-Qushashiah car park is close to Al-Haram and the commercial area. Distance between this car park and Al-Haram and the commercial area varies from 200-300

Plate 6.4 Hazardous approach to Al Qushahia car park in central Makkah; the main road (left) cuts across the approach road. (Photo: Z.A. Mekki, 1986.)

Plate 6.5 Exit from Al Qushahia car park where roads merge dangerously. (Photo: Z.A. Mekki, 1986.)

Plates 6.6 and 6.7 . Hazardous entrance and exit at Al Hegoon car park. (Photos: Z.A. Mekki, 1986.)

metres. This is considered a short walking distance. In contrast, the distance between Amir Path car park and Al-Haram and the commercial area is about 950 metres, which is a substantial distance. Motorists have to be prepared to walk this distance when they cannot park in Al-Qushashiah car park. Pedestrians also have difficulty crossing the road to reach Al-Haram or the commercial area.

It can be concluded that the present car parks require revision from the city engineer to correct defects and to avoid further mistakes when building new car parks, in order that all drivers' demands may be met.

6.3.3 Hourly Demand Variation

One way of analysing the demand throughout the day is to measure patronage by showing arrival times [13] in order to learn the percentage for each change of hour. The analysis of the hourly variation will be based on the two car parks together. Fig. 6.5 illustrates the demand variation during the day, showing two peaks. The first peak starts at about 06.00 gradually rising to a zenith at between 10.00 and 11.00. After this, demand falls, reaching a nadir between 13.00 and 15.00. During the morning peak, 12.1% of the day's motorists arrived between 06.00 and 09.00, a proportion of this group being city centre workers. 30.9% of drivers arrived between 09.00 and 12.00, which is quite a high proportion, reflecting the high demand for parking in

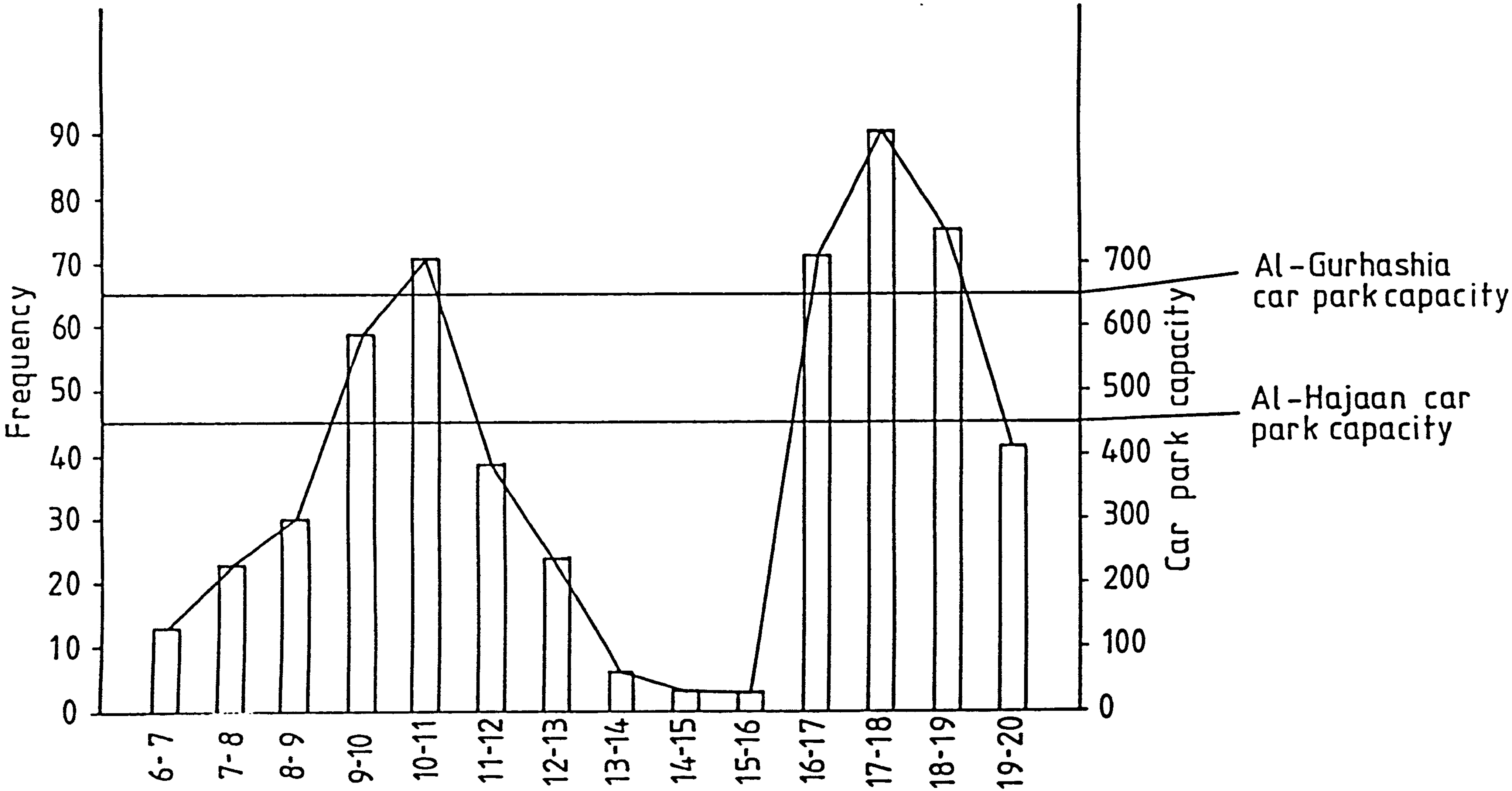


Fig.6.5 Hourly demand variation

SOURCE FIELD WORK 1985

order to accomplish errands in the city centre. Included in this are merchants, businessmen, shoppers and those who come for Dzuhar prayer. The demand between 13.00 and 16.00 is very low, with about 2% of drivers using the car parks. The reason for this is that most people are at home, but perhaps visitors use the car parks, since visits to Al-Haram are made at any time.

The other peak starts between 16.00 and 20.00 and is slightly higher than that of the morning, reflecting the high demand for parking facilities in the Al-Haram area (the city centre). This peak also includes city inhabitants who wish to go out during the evening when it is cooler. Some of those who use the car park at this time also come to the area in the morning peak. The reason for this is that people coming to Al-Haram to pray usually come five times a day for the five daily prayer sessions (in the morning, noon, afternoon, sunset and after sunset). In addition to this, workers in the city centre who run their own businesses usually work two shifts during the day. One shift is from 07.00 to 13.00, the second from 16.00 to closing time. Between the two shifts, the day is at its hottest, when people go home for a meal and a rest and to attend the Asar prayer time. At these hours, there is much traffic movement around Al-Haram and the commercial area.

6.3.4 Daily Demand Variation

The purpose of this section is to ascertain the demand variation between weekdays. The analysis of the demand will be based on the data obtained from the manager of the car parks. The discussion of the daily variation will be based on Al-Qushashia car park as there is no data available for Amir Path car park. The data obtained represents the daily accumulation of cars for the second week in the month of Shawal 1984. Fig. 6.6 shows the variation in daily demand. From this it can be seen that the daily demand from Saturday to Wednesday is virtually identical, and that Thursday and Friday form a peak. This is because they are the days of the weekend holiday, which is different from the weekend in Britain. The demand for parking during these two days is very high, because visitors from outside the city usually visit Al-Haram to perform Ummra (little Hajj). Also, more city inhabitants come to pray in Al-Haram, particularly at the time of Friday prayer when large influxes of people come from within the city and from surrounding cities. On Fridays, the car park is kept full from about 09.00 until 14.00. Also, there is intensive use of the car park on Thursdays, after the Asar prayer until midnight [14]. From Fig. 6.6 it can be seen that about 1,944 vehicles on average parked here every day. This does not take into account the differences between weekday and weekend demand. This number, divided by the hours of a 12 hour day averages 162 vehicles per hour. This number seems fairly small if length of parking time is not considered.

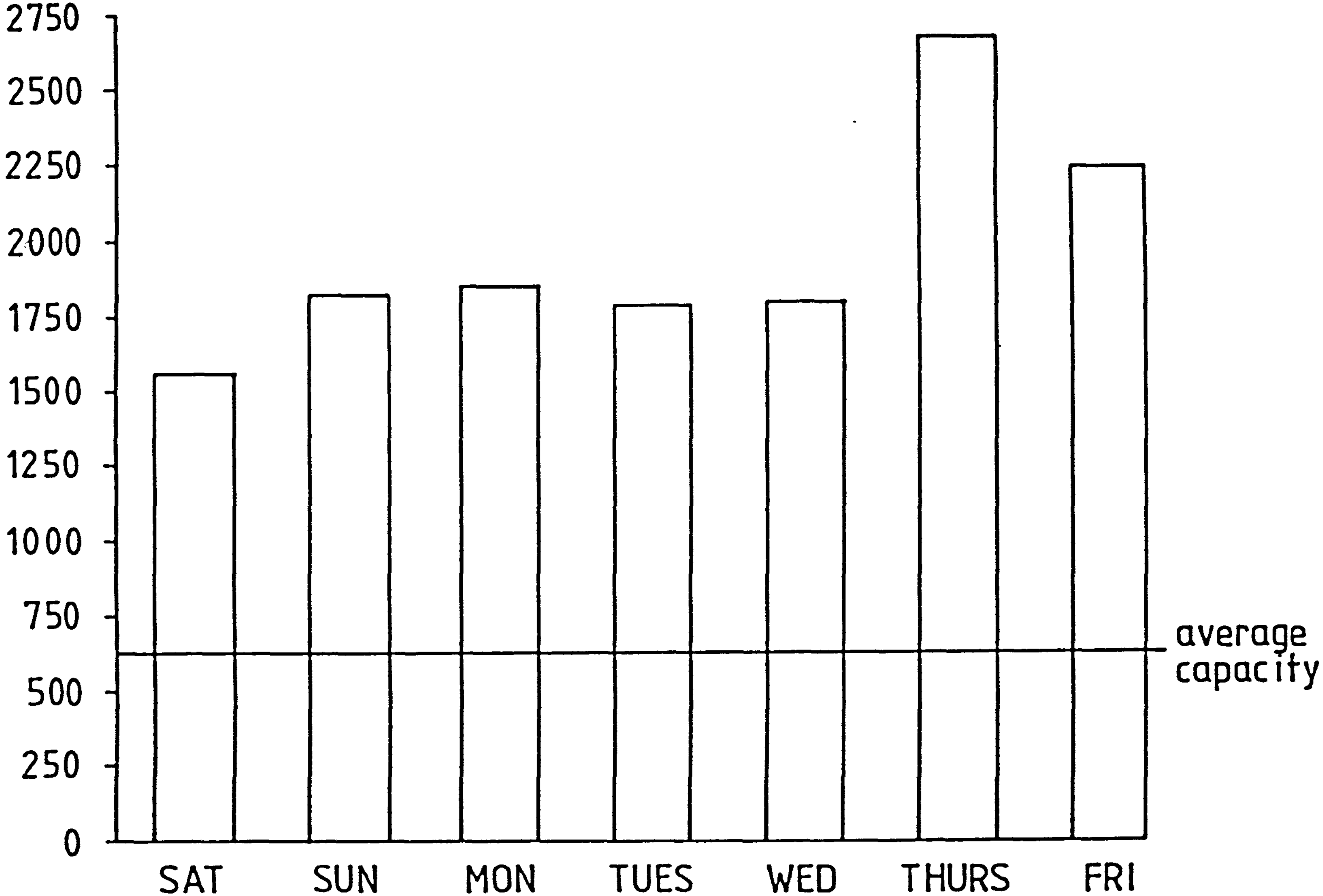


Fig.6.6 Daily variation
Source:The Car Park Operater,Makkah.(1984).

Another reason for the low number of parked vehicles is that both this car park and Amir Path car park compete with free on-street parking around Al-Haram (see Plate 6.7), therefore limiting the use of the two car parks. In addition, the permit issued to drivers by the Traffic Control Board, allowing them to park for a short while around Al-Haram at prayer time, also encourages motorists away from the car parks (see Plates 6.8 and 6.9).

6.3.5 Monthly Demand Variation

> The first aspect of the parking demand to consider is the variation throughout the year. In a given location, the same pattern will probably repeat itself year after year, except as it reflects major social and economic changes: gasoline rationing in wartime, for instance (15).

During the year, the seasonal pattern shows several peaks in the use of the two car parks. The seasonal demand for parking usually occurs during the holiday which falls between the two national school terms, when most of the people in the city of Makkah and cities of the Kingdom usually visit Al-Haram to perform Ummra. This keeps Al-Haram very busy with visitors' vehicles and creates pressure on car park usage and on street parking spaces. The other peak usually comes in the second half of the month of Shaaban, because most of the city inhabitants come to the commercial area then to buy things for the month of Ramadan. For example, they purchase certain kinds of food and spices which they cannot buy elsewhere. A significant peak is also reached during Ramadan when both traffic flow and demand for

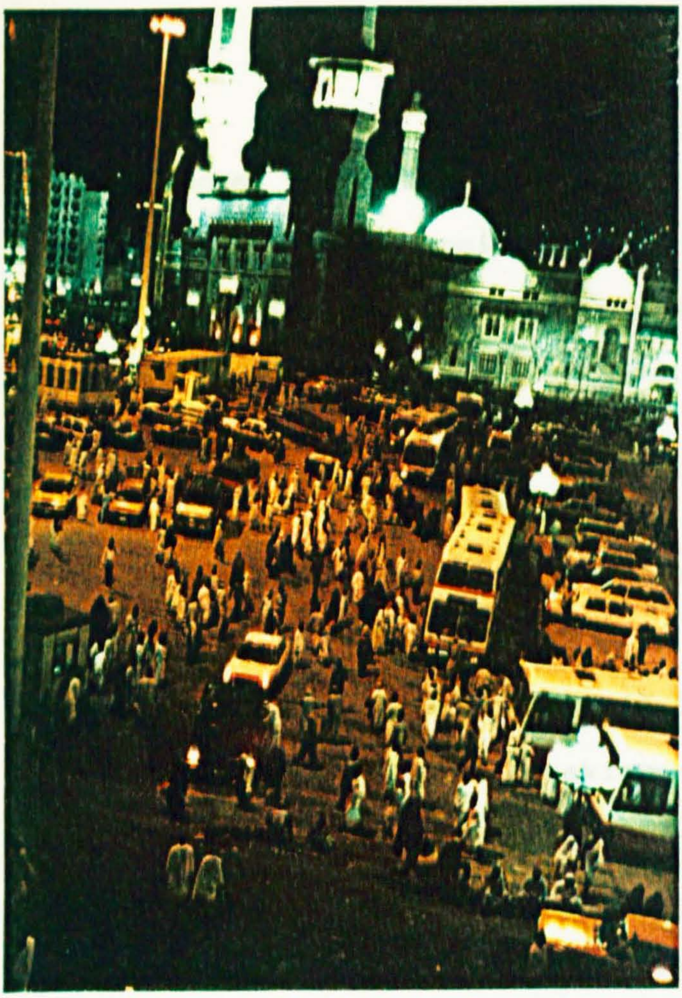


Plate 6.8 On-street car parking around Al-Haram. (Photos: Z.A. Mekki, 1986.)

Plate 6.9 Short-term parking around Al-Haram allowed by the traffic police at prayer times, causing severe congestion. (Photos: Z.A. Mekki, 1986.)

parking spaces reach critical levels. There is a huge influx of visitors at this time, coming to Al-Haram to perform Ummra. The reason why people visit the city in such vast numbers in order to carry out Ummra is due to the Muslim's belief in what the Prophet Mohammed said:

Ummra in Ramadan is equal to Hajj (in reward) (16).

Thus, it is not surprising that many visitors come to Al-Haram at this time.

The number of parked cars in Al-Qushashia car park during this month was 92,919 (17), making a daily average of 3,098 vehicles. Unfortunately, this is the only figure we have since no more data were provided by the manager of the car parks. The car park entrance usually closes when it is getting full and drivers leave their cars for long periods of time, which prevents others from using the facilities (18). This results in the widespread use of streets around Al-Haram and streets near to it (see Plate 7). In addition to peaks in demand mentioned above, there is a great demand for parking during Hajj.

6.4 Journeys to Car Parks

The purpose of this section is to ascertain whether journeys to the car parks are made from parts of the city or from separate cities. The intention is also to discover the relative number of these journeys in relation to those made from outside the city. Distance between origin and the car parks has been taken into consideration, in order to discern whether it affects car park use (ie. the greater the distance, the less the car park is used). These last two points will be discussed in the following sections. The reason for using the car parks will be ascertained and also the destination to which drivers travel on leaving.

6.4.1 Origin of Car Park Users and Destination After Driving Away

The study revealed that the origins of some drivers were districts in the city and others were from outside. Table 6.1 shows the origin of motorists coming to the two car parks. It can be seen that there is a marked difference between the proportion of trips produced by different districts, due partially to the residential population, but also to the small number of valid samples received from the field survey. Of trips originating outside Makkah, the purpose of which is to visit Al-Haram, Jeddah and Taif produce the most. The percentage of people coming from Jeddah and Taif seems very high, but this is because the distance between them and Makkah is short, the journey taking about an hour on average. Some cities form a smaller proportion because of the great distance between these cities and Makkah.

Table 6.2 shows that, after leaving the car parks, a majority of drivers (about 79%) go home; 5.7% go to continue shopping elsewhere; others visit a friend (4.4%) or relative (5.5%); 2.6% travel elsewhere for pleasure; (1.5%) have a religious purpose in travelling to Al-Madina, where there is the Mosque and tomb of the Prophet Mohammed.

Table6.1 Origin And Destination Of Motorists After Leaving Car Parks.

Origin In & Out Of The City	Frequency	%	Destination In & Out Of The City	Frequency	%
Al-Haram Area	1	0.2	Amir Path	2	0.4
Amir Path	2	0.4	Al-Qushashiah	2	0.4
Al-Qushashiah	3	0.5	Ajiyad	6	1.1
Ajiyad	9	1.6	Al-Missfalah	9	1.6
Al-Missfalah	7	1.3	Al-Tundbawy	12	2.2
Al-Tundbawy	12	2.2	Al-Hindawiah	23	4.2
Al-Hindawiah	25	4.6	Harat Al-Bab	3	0.5
Harat Al-Bab	2	0.4	Jarwal	10	1.8
Jarwal	13	2.4	Al-Zahara	5	0.9
Al-Zahara	6	1.1	Al-Nuzha	17	3.1
Al-Nuzha	20	3.6	Al-Zahir	32	5.8
Al-Zahir	23	4.2	Al-Utaibiah	28	5.1
Al-Utaibiah	16	2.9	Al-Jumizah	1	0.2
Al-Jumizah	2	0.4	Al-Maabdah	58	10.6
Al-Maabdah	58	10.6	Al-Khansa	5	0.9
Al-Khansa	7	1.3	Al-Aziziah	113	20.6
Al-Aziziah	78	14.2	Muna	3	0.5
Muna	8	1.5	Kudi	1	0.2
Kudi	2	0.4	Al-Rassifiah	13	2.4
Al-Rassifiah	16	2.9	Al-Shishah	4	0.7
Al-Shishah	5	0.9	Al-Rudah	1	0.2
Al-Rudah	2	0.4	Al-Adel	11	2.0
Al-Adel	12	2.2	Al-Qashalah	2	0.4
Al-Qashalah	5	0.9	Al-Hajj Street	1	0.2
Al-Hajj Street	3	0.5	Al-Faisaliah	6	1.1
Al-Faisaliah	6	1.1	Al-Taneem	3	0.5
Al-Taneem	4	0.7	Al-Awaly	3	0.5
Al-Awaly	3	0.5	Arafat	9	1.6
Al-Sharaiia	6	1.1	Al-Sharaiia	6	1.1
Jedda	84	15.3	Jeddah	75	13.7
Al-Madina	8	1.5	Al-Madina	11	2.0
Taif	69	12.6	Taif	57	10.4
Al-Jamon	3	0.5	Al-Jamon	3	0.5
Riyadh	8	1.14	Riyadh	4	0.8
Fatmah Valley	1	0.2	Fatmah Valley	1	0.2
Alleth	2	0.4	Alleth	2	0.4
Kuwait	4	0.7	Kuwait	1	0.2
Al-Bahaa	8	1.5	Al-Bahaa	4	0.7
Baljourshi	3	0.5	Baljourshi	1	0.2
Dahran	1	0.2			
Abha	1	0.2			
Total	548	100%		548	100%

Fieldwork, Makkah 1985

Table 6.2 Purpose of Final Destination

Purpose	Frequency	%
Home	429	78.3
Private	1	0.2
Work	9	1.6
Shopping	31	5.7
Religious	8	1.5
Studying	2	0.4
For pleasure	14	2.6
To visit a friend	24	4.4
To visit a relative	30	5.5
Total	548	100.0

Source: Fieldwork, Makkah 1985

6.4.2 Journey by Distance to Car Parks

The purpose of this section is to ascertain whether or not the demand and trips are affected as the distance increases. Table 6.3 shows the distance between the car parks and origin of drivers and their frequency. It is noticed from the Table that the number of visitors coming from 1km to 3km is very low, because they are able to walk or use public transport in this instance. The largest proportion (95.5%) is formed by drivers travelling from 3-10km. This gives a good indication when taking into account the demand in relation to future planning. Those from distances greater than 10km are travelling from outside Makkah, while those travelling less than 10km generally come from locations within the city.

Table 6.3 Distance Between Car Parks and Origin

Distance	Frequency	%
Less than 1km	7	1.3
From 1 to 2km	8	1.5
From 2 to 3km	10	1.8
From 3 to 4km	54	9.9
From 4 to 5km	72	13.1
From 5 to 6km	91	16.6
From 6 to 7km	48	8.8
From 7 to 8km	14	2.6
From 8 to 9km	17	3.1
From 9 to 10km	24	4.4
More than 10km	203	37.0
Total	548	100.0

Source: Fieldwork, Makkah 1985

6.4.3 Purposes of Using the Car Park

The study reveals that the most significant purpose of using the car parks is religious (59.3%) (Table 6.4). The religious purpose includes those who come for daily prayer and those who perform Ummra, reflecting the importance of Al-Haram as mentioned above. It is not surprising to find visitors' vehicles parked in large numbers around Al-Haram once the car parks are full. Since the proportion of those using the car parks for religious reasons is very high, this must be taken into consideration by the city planner. Shopping is the second most important reason for using car parks (24.1%). This proportion seems quite high, which demonstrates the importance of the commercial area (Suk) next to Al-Haram. This suk has importance because of the Gold Market which is unique to the city. Also, some shops sell very high quality and fine Indian spices and foods, coming from some Asian countries such as Malaysia and Indonesia. Moreover, it has some shops which sell traditional perfume and clothes which cannot be obtained elsewhere.

The reason third in order of importance for car park use is that of work (16.2%) when they are used twice daily. Thus, it has been established that the three most important reasons for use of the car parks are: religious, shopping and work. Other reasons are less significant.

Table 6.4 Purpose of Using the Car Park

Purpose	Frequency	%
Private	2	0.4
Work	89	16.2
Shopping	132	24.1
Religious	188	34.3
For Ummrah	137	25.0
Total	548	100.0

Source: Fieldwork, Makkah 1985

6.5 Habits of Motorists Using Multi-Storey Car Parks

The purpose of this section is to discover how frequently drivers use the car parks, thereby establishing the concept of demand daily, weekly and monthly. The duration of parking time will be discussed, in order to establish the car parks required in the future, both short-term and long-term. Points mentioned above will be discussed in the following sections.

6.5.1 The Frequent Use of Car Parks and Multiple Visits

The definition of the frequency of use is how often drivers use car parks, whether it is every day, every week or every month. In addition, an enquiry was made in the survey about the number of times motorists use car parks during the day, week or month, in order to discover whether or not multiple visits were made.

Table 6.5 shows the frequent use of car parks in the city, which 26.1% of drivers use every day. From the proportions, it can be seen that those who use the car parks every day are mainly workers in the city centre, those coming to finish jobs and those who usually attend Al-Haram to pray every day. 41.2% of motorists use car parks on some of the weekdays, which may be when they have the opportunity to travel to Al-Haram, from within or outside the city. Equally, some of this proportion may constitute shoppers visiting the city centre. 32.7% of drivers use car park facilities every month, which may be due to living at a great distance.

Table 6.6 illustrates the frequent use of car parks throughout the day. It refers to the need of workers in the city centre to travel backwards and forwards twice a day to run their businesses. There are also those who come for the five daily prayers. Additionally, there is great demand for the repeated use of car parks weekly and monthly. Thus, it can be concluded that there is great demand on the facilities provided by the multi-storey car parks for frequent visits, daily, weekly and monthly. This must be taken into consideration in future planning.

Table6.5 Frequent Use of Car Parks

Frequent use	Frequency	%
Daily	143	26.1
Weekly	226	41.2
Monthly	179	32.7
Total	548	100.0

Source: Fieldwork, Makkah 1985

Table6.6 Multiple Visits

Frequent use	Multiple use One	Two	Three	Four	Five	Raw Total	%
Daily	73	54	7	8	1	143	26.1
Weekly	87	90	38	9	2	226	41.2
Monthly	127	43	7	2	-	179	32.7
Total	287	187	52	19	3	548	100.0

Source: Fieldwork, Makkah 1985

6.5.2 Duration of Parking Time

The discussion of this section will be based on the duration of parking times in the car parks, according to purpose of use. Table 6.7 shows that 53.8% of drivers use car parks for a period of one or two hours, while 28.3% park for three hours. Only 5.3% park for a length of time ranging from 6-12 hours. It is noticed from the Table that some motorists (3.1%) use car parks for 12 hours and up to more than two days. Based on the result obtained from the survey, parking demand can be classified into three categories, according to duration of parking purpose. Short-term parking (1 - 3 hours), which is mainly required by shoppers and businessmen. Long-term parking (4 - 12 hours), for workers and employees in the city centre. This latter group keeps many spaces occupied for a long period of time, depriving others of the use of the car park facilities, effectively leading to parking in the streets around Al-Haram.

The third category is difficult to define due to length of parking, i.e. from one day to more than two. Usually, those who do this are visitors from outside Makkah who come to Al-Haram. This causes more problems for other drivers who normally use the car parks. It can therefore be concluded that the available multi-storey car parks will fail to meet all categories of demand, because of the length of stay involved. Unless more parking facilities can be provided to alleviate difficulties, problems will continue to arise.

Table6.7 Duration of Parking

Purpose of parking / Time of parking	Private	Work	Shopping	Religious	Ummrah	Raw total	%
From 1 hour to 2	1	33	100	149	12	295	53.8
From 2 hours to 3	1	30	28	33	63	155	28.3
From 4 hours to 6	–	2	3	4	42	51	9.3
From 6 hours to 12	–	24	–	3	3	30	5.5
From 12 hours to a day	–	–	–	–	14	14	2.5
From 1 day to 2	–	–	–	–	1	1	.2
More than 2 days	–	–	–	–	2	2	.4
Total	2	89	131	189	137	548	100.0

Source: Fieldwork, Makkah 1985

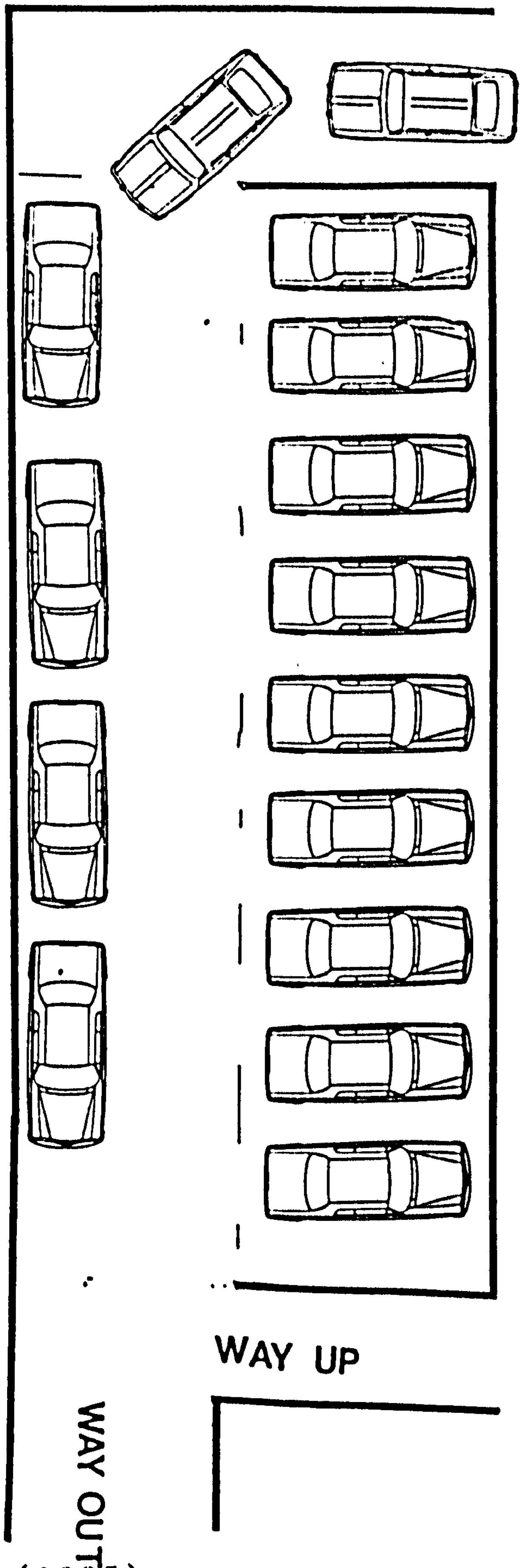
6.6 Problems Encountered by Motorists Using Multi-Storey Car Parks

The purpose of this section is to ascertain what problems face motorists using the car parks. The reason for this is that the convenience, safety and speed with which cars may be moved into and out of storage determine the economic and functional success of the parking operation (19). Availablity of spaces in the car parks, the ticket system and general requirements are also considered important factors in determining whether or not the car parks are satisfactory. They affect the functional and economic use of the car parks. Unless requirements are met, drivers will add to the widespread use of street parking around Al-Haram.

In the survey conducted in 1985, we included five problems to be selected by motorists while answering the questionnaire, as well as three essential requirements to be provided by the car parks. In addition, motorists had the opportunity to specify any problems not included in order that they should not be restricted by the form of the survey. The problem faced in the analysis is one of "multiple response" which encourages us to analyse each problem separately according to percentage obtained from all drivers.

Table 6.8 shows the percentage of those who responded to each problem singly, as it affected them inside the car parks. 25.4% of drivers found places unavailable in the car parks. This usually occurs when the car park is getting full which encourages drivers to park along one side of the loop road giving access to the upper floor of the building (Fig. 6.7), as an alternative. Many drivers had to wait a long time before finding an available space. Those unwilling to do so parked on the streets around Al-Haram, doubling the parking problem in the city centre. 70.4% of motorists complained about the slow speed of movement, due to visitors unaccustomed to the car parks. These latter tend to travel far away from the car in front and to look on every floor for spaces. 65.3% of drivers complained about the ticket system, since they were charged for time taken to find a space before actually parking. The charge is made from the moment of entry up until exit. Motorists were annoyed that, due to the time taken in finding a space, they had to pay for a two hour stay when their intention was only to stay for one hour. This factor was considered a reason for parking around Al-Haram in large numbers, since there is neither time limit nor charge there. Thus, car park revenues are affected. 50.5% of drivers found access to parking spaces difficult. This usually occurs when cars are parked at random, occupying the space of two cars. Cars parked on the loop road also makes access difficult. The car park managers need to organise parking in order that the economics of the car park should not be affected. 38.5% of motorists were unhappy about the level of security in relation to the unrestricted movement of pedestrians within the car parks. Notices are displayed, warning drivers not to leave anything in

Fig.6.7 Vehicles Parked Illegaly on Side of the Loop road inside Multi-storey Car Parks(1985).



Source:Field Work,Makkah,.(1985).

their cars, but if they do so, it is at their own risk. No report concerning burglaries from car parks has been obtained (20).

Table 6.8 Problems Which Face Drivers While Using Car Parks

Type of problem	Number of responses	%
Number of places available	139	25.4
Speed of movement too slow	386	70.4
Unsuitable ticket system	358	65.3
Access to parking space	277	50.5
Security in the car park	211	38.5
Insufficient elevators	240	43.8
Absence of cafeteria	459	83.8
Absence of toilets	69	12.6

Source: Fieldwork, Makkah 1985

Drivers must pay attention to the flow of cars when walking to or from the elevator. 43.8% of motorists complained about the insufficient number of elevators. In 1986, we made a visit to these car parks and found the elevators inoperational, awaiting repairs. This created another hindrance for drivers who were in a hurry to attend prayer on time or to catch the shops before they closed. Disabled people encountered considerable difficulty when using the stairs. In any case, there is great pressure on elevators because there are not enough of them.

About 84% of drivers complained that there was no cafeteria, selling sandwiches and fresh juice. We believe that establishing a cafeteria inside car parks would not be economically viable, since it would only be serving motorists and they could equally well go to restaurants round Al-Haram if they so wished. Approximately 12.6% of drivers complained that there were too few toilets. We think that there is no solution to this problem within existing car parks. Also, motorists can use public toilets which are close to the car parks, since toilets are needed when drivers have to make ritual ablution before prayer.

Drivers were asked if they would be prepared to pay more for parking if there were better services and of the type they required in existence. (The extra revenue would be used to alleviate problems and improve car parks in order to meet motorists' requirements.) The study revealed that 74.8% of motorists would not pay more for better services, while 25.2% agreed to pay more for improving car park facilities. This latter proportion appears somewhat low. If the cost of tickets were increased, it might discourage motorists from using the car parks. In spite of the marked difference between those who would pay more and those who would not, we encouraged both to make suggestions towards the improvement of the car parks. The aim of this was to make the requirements of all drivers clear to the city planners in order that they may be taken into consideration for future car parks.

Table 6.9 illustrates the general requirements of drivers. The most significant need is to increase the number of elevators. We consider this to be essential because disabled people who use the car parks cannot climb up and down stairs. The Table also shows other needs which will be discussed when considering improvements. About 3% of drivers would like air conditioning installed in the car parks. This would reduce the temperature resulting from the hot weather and the heat of the car engines. We consider this impractical because it is too expensive and would necessitate enclosing the car parks, thus creating problems relating to exhaust fumes. Approximately 9% of motorists would like water cooling facilities to exist. After walking to the car parks in hot weather, motorists need to drink cold water. Such facilities are necessary and inexpensive to provide. 8.2% of drivers would like car parks to be enlarged, since those already in existence have a very small capacity which cannot meet demand. While these car parks, which were designed six years ago, cannot be enlarged, new ones should be built in order to relieve congestion in streets around Al-Haram. About 3% of drivers wish the administrators of these car parks to organise the movement of vehicles inside them, in order that its speed may be increased. 6.6% of motorists would like more than one entrance to car parks because long queues form and cause delay at busy times. This point must be taken into consideration when planning new car parks. The reduction of ticket cost was requested by 2.2%. This proportion is very small and the ticket cost would appear reasonable.

Table 6.9 General Services Required

Type of service required	Frequency	%
Elevator	237	43.2
Cafeteria	75	13.7
W.C.	16	2.9
Air conditioning	7	1.3
Drinking water	49	8.9
Car park enlargement	45	8.2
Traffic movement organisation	16	2.9
Allow families to enter car parks	2	0.4
More entrances	36	6.6
Reduction of ticket cost	12	2.2
Organisation of parking method	38	6.9
Cleaning of car parks	9	1.6
Better lighting	6	1.1
Total	548	100.0

Source: Fieldwork, Makkah 1985

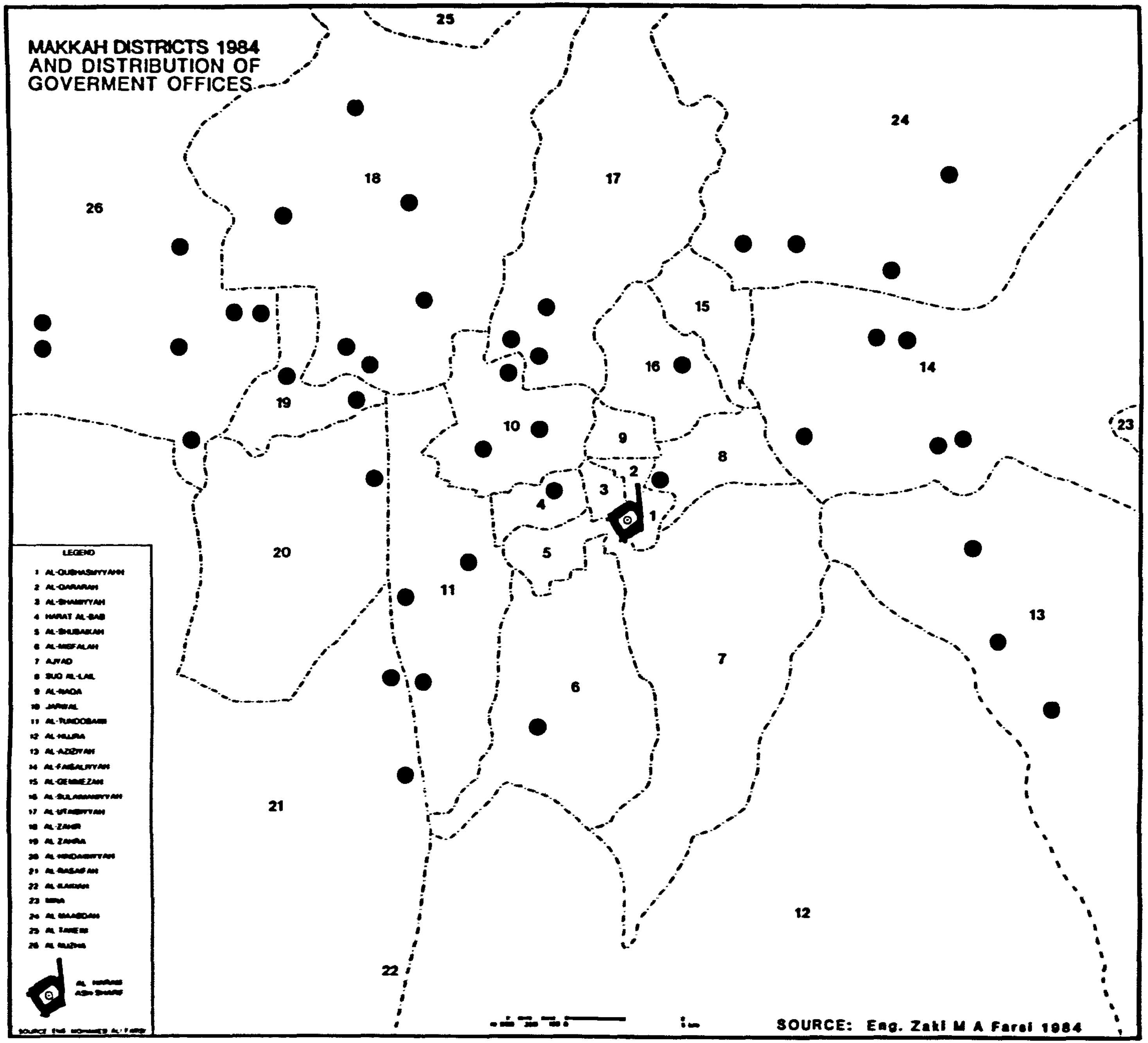
No one mentioned the lack of fire extinguishers. These important safety factors in case of fire, were not in existence in 1986.

From the foregoing, it can be seen that these car parks require many improvements and much consideration must be given to the planning of future car parks.

6.7 Car Parking Demand at Government Offices

The activities carried on by people in the city are markedly intermingled, especially after the rapid growth of the city. This rapid growth led to the building of new centres in different parts of the city. These are situated at some distance from one another, necessitating fast travel by car between them. Employees in government offices travel to and from centres in the city, as do members of the general public who have work to be dealt with in them.

Most of the government offices are scattered in various parts of the city. They are not distributed scientifically (Fig. 6.8) because in most instances, they occupy rented buildings in residential areas. They were originally designed to accommodate families and not offices. Rented buildings have no car parking facilities which employees can use. Some of the properties are easily accessible, being on main streets, but others have to be reached by driving along secondary roads and alleys.


MAKKAH DISTRICTS 1984
AND DISTRIBUTION OF
GOVERMENT OFFICES
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SOURCE: Eng. Zaki M A Farsi 1984

Fig.6.8

According to their distribution and function, some offices have few visitors, but require all day parking for some of the staff; while others have more visitors, needing short-term parking. In general, all government offices should have two types of car parks:

a) long-term for staff members using their cars;

b) short-term for visitors who usually spend about two hours at these offices to accomplish what they need.

The demand for parking at government offices usually occurs during the five weekdays (Saturday to Wednesday), between the hours of 08.00 and 14.00. During these hours workers and visitors compete for parking spaces. Insufficient parking spaces are available, and therefore on-street parking is widespread. Employees who reach the offices first usually occupy most of the kerbside parking, which leaves visitors no alternative but to double park or block park, thereby causing congestion.

Table 6.10 illustrates the number of vehicles parked on streets within 50 metres of some selected government offices, which are important because of the number of people who usually go to them. These offices were organised into groups and one day was devoted to each group, for the purpose of counting vehicles parked on the streets near the office locations. Due to lack of time and manpower, no longer could be spent on this aspect of the survey. It is noticed from the Table that about one third of the government offices has the largest proportion of visitors.

Table 6.10 The Number of Vehicles Parking on Main Streets at Government Offices in Makkah, 10 - 12 June 1986, Between 08.00 and 13.00 Hours.

Car parking zone by office name	Location district	Number of Vehicles
The First Justice Office	Jarwal	100
The Second Justice Office	Jarwal	70
Main Municipality	Al-Jamiza	450
Third Sub-municipality	Al-Missfalah	56
Sixth Sub-municipality	Al-Mansoor	95
Al-Haram Sub-municipality	Al-Haram Area	50
Main Education Office	Al-Aziziah	50
Canonical Court	Al-Rudah	70
Makkah Province	Al-Shisha	50
Nationalities Affairs	Al-Zahir	590
Ministry of Pilgrims	Al-Taniim	470
Traffic Police Office	Al-Nuzha	500
Authority of Water and Sewage	Al-Rassifah	120

Source: Fieldwork, Makkah 1986

The National Affairs Office attracts the highest number of visitors. Every day many people are expected to visit this office to acquire an identity document or to have a wife or child's name added to this latter. As this is the only office in the city dealing with this kind of documentation, transport is needed to travel to it, since it is located in the north-west part of the city and is not readily accessible on foot. There is therefore great pressure on parking spaces in the streets near this office. The Traffic Police Office at Al-Nuzha, in the west of the city, has a similar number of parked cars on the streets. Many people are expected to visit this office in order to obtain driving licences or to renew them. Many also come to this office to pay road tax or a fine for permission to repair a car after an accident. This office has surface car parking for 50 cars. However, this car park is largely given over to vehicles waiting to be checked by the police engineer in order that road licences may be renewed, which therefore prevents visitors from using it, forcing them to park by the kerb. This serves to reduce the capacity of the main road leading to Jeddah. Parked cars or drivers in the process of parking can cause a serious accident, since vehicles travel very fast on the Jeddah-Makkah old road. This problem requires a great deal of attention from the city authority and the Traffic Department in order to correct it and prevent kerbside parking on the expressway. The Ministry of Pilgrims in Al-Taniim district also faces a similar problem to the offices already discussed. This office is located on the expressway leading to Al-Madina and it can only be reached by car, which results in great demand for parking spaces. Some vehicles are parked by the expressway which can result in serious accidents. The main Municipality Office at Al-Jumizah district does not experience such acute parking problems as it might, since there are now 12 sub-offices, located in the districts, which alleviate the pressure on the main office, providing the same service locally [21]. This system spreads parking demand. The remainder of the offices studied appeared to have less parking demand, but this might not have been representative since the study was limited to only one day.

It is obvious that there is a demand for parking spaces at government offices, since the streets around them are heavily used by employees and visitors. This leads to obstruction of traffic flow. Unless this problem is solved, it will become acute in the future, due to increase in population and vehicle numbers.

6.8 Car Parking Demand in Residential Areas

> Car parking facilities in residential areas are the most essential requirement for people who live there and have cars. This is because a car spends a high proportion of its life in storage. It has been calculated (doubtless on insufficient evidence) that the average car is in motion only 500 hours per year. The remaining 8260 hours it is left parked on a paved surface (22).

Vehicle parking in residential areas is becoming an ever-increasing problem. It is most acute in older areas where houses abut. These houses were built before and during the advent of motor vehicles in the city. Since the number of vehicles has increased in the city, so has the demand for parking spaces. Naturally, with no facilities for parking, other than on the street, the problem in the city has become pronounced and complicated. The heavy use of on-street parking has been influenced by various factors. One of these is the complex relief, where mountains reduce the flat land available for parking. This can be recognised particularly where the Makkah Valley becomes very narrow, such as in areas around Al-Haram. Houses built on the mountains have no car access. There is competition for parking spaces between those living on the hills and those at the bottom. Everyone wishes to park in a convenient place, as close to his home as possible. Numerous houses have been built without garages and many of them accommodate five families, each owning one car or more. This obviously causes acute parking problems. Hypothetically, if one building consists of five floors, with a family on each floor and each family owning one car, the area of the building being $225m^2$, then the street area required for parking is $70m^2$, which involves taking up space in front of the next building. Thus, anyone moving his car from a space is likely to experience difficulty in finding another upon his return, especially if it is late in the evening. This may result in driving round in search of a space and eventually parking several hundred metres from home. The problem of parking places is similar in all densely populated residential areas which lack car parks. This is because of the original planning and the complex geographical features of the city. The problem of on-street parking involves not only main streets, but also secondary streets and alleys. Excessive parking in alleys, which are mostly cul-de-sacs, causes tremendous difficulties for drivers who need to turn round because they cannot find a parking place. Furthermore, the obstruction caused by on-street parking along narrow roads hinders access for emergency vehicles (ambulance, police car, fire engine).

Car parking problems in residential areas are aggravated when there are government offices, schools, shopping centres etc. located nearby, attracting more cars to the area. Visitors also increase the parking problem in residential areas and this is particularly noticeable near Al-Haram.

Generally, the high levels of demand for parking occur in high density residential neighbourhoods such as Al-Qushashia, Al-Missfalah, Al-Shubikah, Ajiad, Amir Path, Al-Tundbawi, Al-Utibah, Al-Maabdah, Al-Faisaliah, Al-Hindawiah and Al-Zahir, which all experience parking problems. It is usually observed in these neighbourhoods that residents block the roadway with their cars, which require much negotiating, creating congestion for traffic flow. This occurs where insufficient parking facilities are available to meet the demand of all residents. Unfortunately, the Traffic Police Office has no data available concerning number of vehicles in each district, which would give an indication of area occupied by on-street parking in various parts of the city. However, a crude estimation may be made, based upon two elements:

a) the population of each district in 1983;

b) the car ownership per 1,000 capita for the entire city population in the same year.

From these data we can calculate the approximate number of vehicles presently using street parking, and the area needed to remove the use of street parking. The area required for car parking space, in each district of the city, can be calculated using the following equation [23] (devised by the author):

$$A = N \times P \times 14m^2$$

Where:

A = total area required for car parking space in each district;

N = car ownership index (giving car ownership per 1000 capita);

P = population/1000 in a given district;

and

$14m^2$ = the land area required for the parking of one car.

For instance, by the use of this formula, the number of cars owned in Al-Qushashia district (population 1,700) in 1983 (car ownership index 208, i.e. 208 cars per 1000 capita in 1983) can be calculated as follows:

$$\frac{1700}{1000} \times 208 \times 14m^2 = 4956m^2$$

Table 6.11 illustrates the calculation of number of cars estimated in each district of the city. Additionally, the Table shows a great demand for parking spaces in high density areas, mainly around the city centre.

It can be concluded from the Table that the area used for parking on city streets is very large, creating great pressure on the city network.

Table6.11 The Estimated Number of Vehicles by District and Area Required for Parking

District Name	Population number	Estimated vehicles number x $14m^2$*	Estimated area needed for parking m^2*	Area by hectare*
Al-Qushashia	1700	354	4956	0.4
Ajiad	24800	5158	72212	7.2
Al-Missfalah	77200	16058	224812	22.5
Al-Shubikah	14500	3016	42224	4.2
Harat Al-Bab	10900	2267	31738	3.2
Al-Shamiah	7300	1518	21252	2.2
Al-Qurarah	5800	1206	16884	1.7
Suk Al-Lil	8100	1685	23590	2.4
Jarwal	31200	6490	90860	9.0
Al-Naqa	6200	1290	18060	1.8
Amir Path	24900	5179	72506	7.2
Al-Aziziah	13600	2829	39606	4.0
Al-Tundubawi	49800	10358	145012	14.5
Al-Sullimaniah	10000	2080	29120	2.9
Al-Jumizah	9200	1914	26796	2.7
Al-Utibiah	62800	13063	182882	18.3
Al-Maabdah	31900	6635	92890	9.3
Al-Faisaliah	43600	9069	126966	12.7
Muna	2600	541	7574	0.8
Al-Rasifah	6100	1269	17766	1.8
Al-Hindawiah	53400	11107	155498	15.6
Al-Zahra	6200	1290	18060	1.8
Al-Zahir	45000	9360	131040	13.0
Al-Nuzha	7700	1602	22428	2.2
Al-Taniim	4900	1019	14266	1.4
Total	559400	116357	1628998	163.0

Source: Al-Gazawi A.A. 1985 (Arabic)[24]

* Writer's calculation and estimation

With the rapid increase in car ownership and the continuing use of street parking, blockages must be caused in city and residential areas unless a solution can be found. The problem must be solved now, before the situation becomes worse and more complicated, bringing traffic to a stand-still.

6.9 Conclusion and Recommendations

It is obvious from the discussion of car parking demand in Al-Haram area, residential areas and around government offices, that demand for parking spaces is acute. The problems caused by this demand require a thoughtful solution and the establishment of new policies, otherwise on-street parking will contribute towards paralysing the movement of traffic. A possible, if expensive, solution would be the construction of new streets. An economically more viable alternative would be the construction of new car parks. This would also have the merit protecting the environment and enhancing safety of the city. Future plans must strike a balance between car parking demand and traffic movement.

For the city centre (Al-Haram and commercial area), it is obvious that the present multi-storey car parks fail to satisfy the demand of all motorists, since parking around Al-Haram and the commercial area remains widespread. Therefore, new policies must be formulated to control parking demand.

It is a great challenge for the future of the city centre to provide parking spaces for a huge number of cars. As the consultant Robert Matthew recommended, 15,000 spaces for short-term parking and 3,000 spaces for long-term parking should be established for the commercial area. Also, as we estimated, there should be 10,000 spaces to meet parking demand in Al-Haram area. Many houses would have to be demolished to achieve this goal, which would be expensive. So, what would be a satisfactory solution? One suggestion might be to build more multi-storey car parks as an alternative to on-street parking. This would require 15 such car parks, each with a capacity for no fewer than 1,500 cars. Houses would have to be demolished in order to achieve this, which would cause housing problems, particularly around Al-Haram where pilgrims come to stay, especially during Hajj. Additionally, the building of more multi-storey car parks would attract more traffic to the city, placing an even greater burden on the network and creating great difficulties for pedestrians. Therefore, this is not the solution to the problem. Is the answer to prohibit traffic from entering the city centre? This would benefit pedestrians, but how would people reach Al-Haram and the commercial area and where would they park their cars?

The proposed recommendation is to adopt the system of park-and-ride at the city outskirts. Motorists would be able to park there in long stay car parks then travel by public transport to their destinations in the city centre. By adopting park-and-ride, the Al-Haram and central areas would be freed from the heavy traffic volume. There should be rapid bus services between these car parks and the city centre. According to C.A.

O'Flaherty:

> In theory, park-and-ride schemes are excellent traffic planning measures. In practice, the degree of excellence achieved is dependent upon how they are used and upon the extent to which the commitments implicit in their usage are understood. Proper usage generally infers that a considerable advantage is to be gained by the user of the scheme, in the form of, say, substantial savings in cost and/or time (25).

In 1986, we conducted a survey of open land on the outskirts of the city in order to see if any were suitable for the adoption of park-and-ride. Three open areas were located in various parts of the city. The distance between them and the city centre varies from 1-2km. One of these areas is located in Kudi district, south of Al-Haram, while the other two are to the east: one is situated in Al-Hejra district, on the road leading through tunnels to Al-Haram; the other is in Al-Aziziah district, just before the tunnels which lead to Al-Haram. During the survey we drove from Al-Haram to each location and found that it only took five minutes to travel the distance (driving at a speed of 30km per hour). These open spaces are considered practical for the type of parking required, those in Kudi and Al-Hejra being capable of accommodating an estimated 15,000 vehicles. It is therefore proposed that park-and-ride should be established on these open spaces. The expense and problems of demolition would be unnecessary and the city centre would be left intact. Heavy traffic flow would be removed from the central area which would also benefit pedestrians.

The open area in Kudi district (see Plate 6.10) would cater for visitors coming from west, north and south (ie. Jeddah, Al-Madina and Jazan) to the city. People coming from these cities can approach Kudi via the third ring road (Fig. 6.9), without becoming involved with local city traffic.

The parking space in Al-Hejra district (see Plate 6.11) would be used by drivers coming from the east side of the city, Taif, Riyadh and neighbouring countries north of the Kingdom. People travelling from Al-Madina could possibly use this parking area.

When creating new car parks, the design specifications should take into account drivers' demands. One section should be for short-term parking, the time range being from one to twelve hours. Another part should be designed for long-term parking, for those staying longer than a day, thereby alleviating parking for long periods in the city streets around Al-Haram.

There should be a frequent bus service between these car parks and the city centre. It is suggested that buses should run every five minutes. The ticket should cost a reasonable amount and the buses should be air conditioned, in order to encourage people to use the car parks and to end the excessive use of on-street parking in the city centre. The bus service should not go into the Al-Haram area (Fig. 6.10), but should loop round outside it. Another bus should transport passengers to the commercial area north of Al-Haram (Fig. 6.10). In addition to that, the same bus can work as a feeder and collecter route toward Al-Haram from buses working on routes to Al-Haram which also should not

Plates 6.10 and 6.11 Open areas at Kudii and Al-Hejra districts suitable for the implementation of a park and ride system in Makkah. (See pages , Chapter 6.) (Photo: Z.A. Mekki, 1986.)

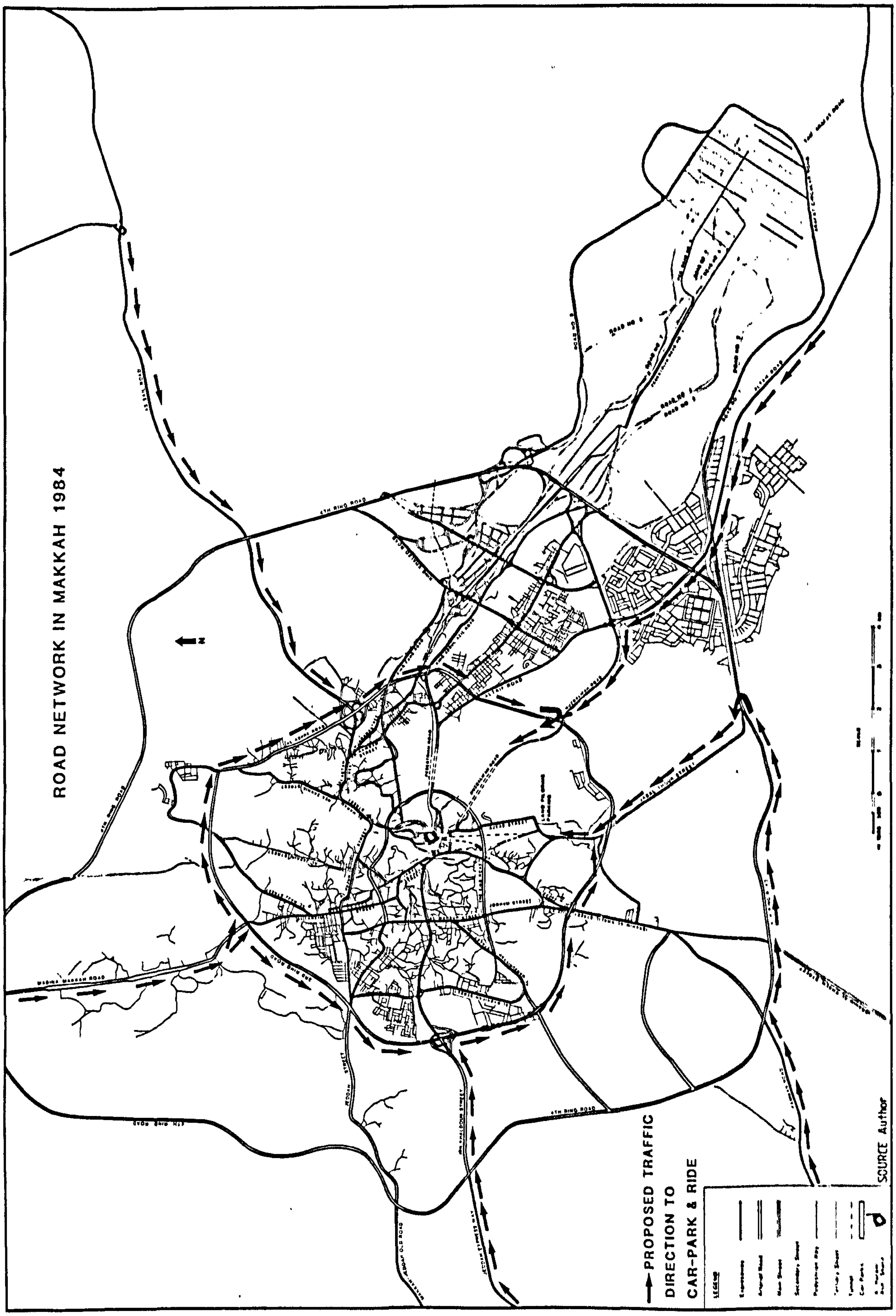
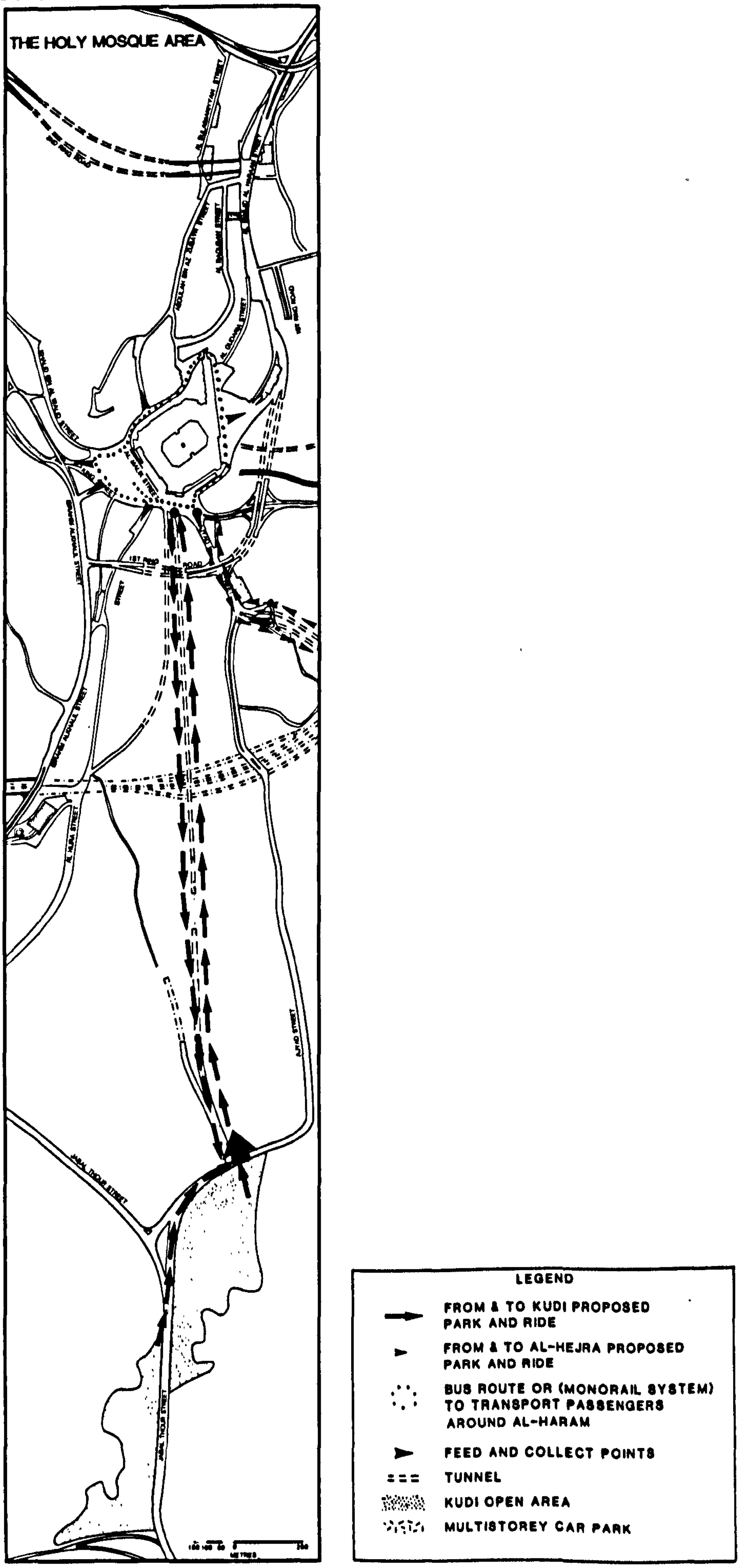

ROAD NETWORK IN MAKKAH 1984
PROPOSED TRAFFIC DIRECTION TO CAR-PARK & RIDE
SOURCE Author

Fig.6.9

Fig.6.10
THE AUTHORS PROPOSAL FOR BUS ROUTES FROM AND TO PARK & RIDE



Source:Field Work,Makkah.(1986)

penetrate the Al-Haram area. In addition to the bus service, hotels should provide mini-buses to transport their guests. There should also be a number of carriages for conveying disabled people from the bus stop to Al-Haram or the commercial area.

Various areas can be adapted for park-and-ride for citizens' use. One of the suggested areas is at the entrance of the tunnels at Al-Aziziah district, leading to Al-Haram, which could serve people of Al-Aziziah, Al-Maabdah, Al-Adel, Al-Shisha, Al-Ruda and Mina. The multi-storey car park at Al-Missfalah can cater for the people living at Al-Tundabawi, Al-Rassifah, Al-Nuzha, Al-Zahir and Al-Zahra. The other area is the exit of tunnel between Jarwal and Al-Falg districts, where a car park could be sited for use by people coming from Al-Utibiah, Al-Jumizah and Al-Sullimaniah. From the car parks, there should be frequent and direct bus services to Al-Haram.

If these parking facilities for visitors and city inhabitants come into being, the traffic to the city centre must be restricted, in order to keep it free for pedestrians. However, there must be a degree of flexibility and police cars, ambulances, fire engines and water carrying vehicles must have access. There should also be access for residents in districts around the city centre. This should be achieved by adapting the two-way system, limiting the possibility of movement to access in and out of the district. There has to be access between these districts which can be effected by connecting them with the inner circular road. Residents should have special stickers in order to prevent other cars from entering for parking purposes.

The conflict between drivers at government offices could be reduced, as of now, by providing a bus service to convey employees from adjoining areas to and from work. This would ease the pressure on street parking around the offices and alleviate the conflict. With reference to future planning, the government offices should be distributed at points around the ring roads and bus services provided to transport people to them.

It is possible to suggest some recommendations which would ease the parking problem in residential areas. It might be possible for residents near the city centre to travel early in the day on the city network. Blocks of garages or open areas could be provided for parking. It is uncertain whether this would be practicable since drivers might consider the parking area to be too far from their homes. Also, if rent were involved, many motorists would not be prepared to pay for the facility and would still street park. Thus, there would still be the problem of obstructing traffic flow and emergency services. It is imperative that a solution be found before the problem becomes more complicated and almost impossible to solve.

Another recommendation is for internal garages to be built in houses. This would be viable if only two families and two cars were involved. However, this would not be viable where there are five families in a building and possibly running more than one car per family.

A certain amount of demolition may still be necessary in order to provide enough parking areas. For people living in the hills, it may be possible to level some parts of the mountains, but in the meanwhile, parking spaces could be provided on the sides of the roads. The levelling would be expensive, but would ease the on-street parking problem.

Those people living in houses on main streets who are unable to make garages on the ground floor may be able to build them in the basements. This latter, if practicable, together with one car per household, would help positively towards solving the parking problem.

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CHAPTER 7

ACCESS TO HOSPITAL SERVICES AND CAR PARKING DEMAND

7.1 Introduction

The Saudi government provides free health services to the entire population of the Kingdom. In the Third Development Plan (1400-1405AH, 1980-1985AD), the health network was expanded and the manpower working in the health sector was enlarged to meet the increase of population demand on health services. The number of beds on hospitals belonging to the Ministry of Health increased from 1.36 in 1980 to 1.53 in 1984, for every 1,000 inhabitants. At the same time, the total number of hospital beds per 1,000 capita in the Kingdom increased from 1.99 in 1980 to 2.23 in 1984. Additionally, the number of doctors in the Saudi Kingdom rose from 6.7 in 1980 to 11.5 in 1984 for every 10,000 persons. Hospitals in the Kingdom increased from 69 in 1980 to 93 in 1984, with a capacity of 18,913 beds, a 35% increase. The number of health care centres rose from 889 to 1306, an increase of 47%, within this same period. The number of hospitals run by other government sectors increased from 40 in 1980 to 52 in 1984, a rise of 30%, while the number of beds increased from 5,579 to 7,497, this being a 34% increase. The Fourth Development Plan (1985-1990) is focusing on expanding the general and primary health care units.

It is obvious from this brief introduction that the focus on extending health services through Development Plans in the Kingdom is the foremost concern of the Ministry of Health. The Fourth Development Plan is specifically orientated to meet the ever increasing demand on this very significant and vital sector.

However, the siting of hospitals has not been mentioned in the planned policies (1).

7.2 The Hospital Services in Makkah

Hospitals in Makkah are considered among the most significant focal points in the city. Health care is one of the most important requirements of people. Thus, hospitals play a significant role in attracting and generating trips from and to various points in the city. It can be expected that people will travel to and from the hospitals every day, throughout the day.

The aim of this section is to establish the present situation of hospitals in relation to their distribution and the habit of people going to them. There are no specific health regulations relating to Makkah. General administration is governed by the Ministry of Health in Riyadh and transmitted via Jeddah (in the western region) to the health officers and hospitals in Makkah and Taif (2).

In 1983, there were five Ministry of Health hospitals in Makkah, besides two hospitals which were privately owned and run, but still remained under the control of the Ministry.

The five government hospitals were: King Abdulaziz Hospital, Ajiad Hospital, King Faisal Hospital, Maternity and Women's Hospital and the Public Security Hospital (3). In 1985, a new hospital was opened, the Hera Hospital. Another hospital has been built, but is not yet in use. This is the Al-Noor

Hospital. Besides hospitals, there are ten government clinics, plus four which are privately owned and run.

The government hospitals and clinics provide free health services for the city inhabitants, Saudis and non-Saudis. The private hospitals and clinics also provide a health service, but this is not free since patients must pay for consultations and prescribed medicines. There are also 27 privately owned and run surgeries.

In general, the distribution of government hospitals and clinics is determined according to the population density in the regions of the Kingdom. In theory, each of the five main hospitals provides services for 40,000 persons in the city (4). This means that they serve 200,000 people between them. Since the city population is 600,000 (1983), it is evident that health services are inadequate. In theory, about 50% of the population are in need of better access to hospitals, creating great pressure on the existing health services. Tables 7.1A and 7.1B show the high demand of out-patients. This figure varies from year to year and from month to month. Table 7.1A illustrates that the demand was high in 1981 and 1982, with the highest demand (Table 7.1B) being in the months of Shawal and Dul-Hijjah. This is not surprising because there is a great influx of visitors to the city at these times, in order to perform Hajj and Ummra. The Saudi government takes responsibility for the health care of these visitors, without charge for treatment or medicine.

Table 7.1A Visitors to Hospitals in Makkah

Year	No. of outpatients	Index	Average out-patient in each hospital/year
1978	1861385	--	372273
1979	1929951	+ 3.55%	385990.2
1980	1806299	- 6.8 %	361259.8
1981	2094462	+13.75%	418892.4
1982	2252841	+ 7.0 %	450568.2

Table 7.1B Monthly Numbers of Patients Visiting Hospitals in 1983

Month	No. of out-patients	Index	Average monthly out-patient/hosp	Daily average out-patient/hosp
Mohamam	319345	--	63869	2128.9
Safar	328097	+ 2.6%	65619.4	2187.3
Rabi I	326075	- 0.6%	65215	2173.8
Rabi II	290926	-12.0%	58185.2	1939.5
Jumad I	315008	+ 7.6%	63001.6	2100.0
Jumad II	278010	-13.3%	55602	1853.4
Rajab	302028	+ 8.0%	60405.6	2013.5
Sha'ban	295477	- 2.2%	59095.4	1969.8
Ramadan	186050	-38.8%	37210	1240.3
Shawal	267313	+30.4%	53462.6	1782.0
Dul-Ga'dah	248253	- 7.6%	49650.6	1655.0
Dul-Hijjah	444445	+44.2%	88889	2962.9
Total	3601027			

Source: Statistical Yearbook 1983, Ministry of Finance and National Economy Tables 3-16 and 3-19

Out-patients have the freedom to go to any hospital in the city, even if it is at a distance from their homes. In the hospitals there is no record system in order to control the movement of people and make admissions well organised. The absence of a filing system, in all but Herra Hospital, makes it possible for someone to visit several hospitals in one day, even if he has already been seen by a doctor. Doctors themselves complain about this (5). Hospitals are overcrowded as a result of this procedure and the increased travelling involved can also lead to traffic congestion and even accidents.

7.3 Location and Distribution of Hospitals

The purpose of this section is to evaluate the nature of hospital locations, fixed in previous years, and their effects on traffic movement today, especially after the rapid expansion of the last 20 years. Another aim is to consider the suitablity of the location and distribution of hospitals in relation to their accessibility and their ability to meet the health service requirements. This should also establish whether distance plays a significant part in affecting traffic movement. Additionally, an attempt will be made to examine the adequacy of the theoretical capacity for each hospital in relation to the population in the surrounding district. This should show whether the hospital services can meet the local demand and the effect of that upon generating trips to other hospitals in the city.

Ajiad General Hospital is located in the city centre of Makkah, just a few hundred metres from the south-eastern side of Al-Haram. It is situated in a densely populated district, being surrounded by tall buildings and its western main gate faces the commercial area. The hospital is served by two streets, the city main street which passes Al-Haram from south to east, and the street which comes from Kudi district, south of Al-Haram. These two roads also service the Al-Haram area, so are extensively used by drivers. A conflict occurs between those drivers going to Al-Haram and those going to the hospital. Since the Ministry of Health has distributed the hospitals according to population density, the theoretical capacity of Ajiad General Hospital to cater for 40,000 out-patients means that it can provide services only for inhabitants of Ajiad district and Al-Shubaikah. Table 7.2 gives the population figures for each district. This encourages people in districts around the city centre to go to another hospital or to endure long waits in the out-patients department. Distances between the hospital and districts it serves vary from approximately less than 1km to 2.5km, rather too far for walking.

The Women's Hospital is located in a very busy district (Jarwal district), and its main gate opens towards the street. The hospital is sited approximately 4km from Al-Haram area. This hospital specialises in maternity and pre-natal care and caters for all the women in the city, which keeps it very busy constantly. Since 1985, two centres for child and mother care

Table 7.2 Population by District

District	Pop. no.	District	Pop. no.
Al-Qushashiah	1700	Al-Sullimaniah	62800
Ajiad	24800	Al-Jumizah	9200
Al-Missfalah	77200	Al-Utaibiah	62800
Harat Al-Bab	10900	Al-Maabdah	31900
Al-Shamiah	7300	Al-Faisaliah	43600
Al-Qararah	5800	Muna	2600
Suq Al-Lil	8100	Al-Rassifiah	6100
Jarwal	31200	Al-Hindawiah	53400
Al-Naqa	6200	Al-Zahara	6200
Amir Path	24900	Al-Zahir	45000
Al-Aziziah	13600	Al-Nuzha	7700
Al-Tundbawii	49800	Al-Taneem	4900
Al-Shabikah	14500		

Source: A. Al Gazawii (1985) Makkah in Shazarat Al-Zahab (Arabic) revised by A.S. Gamidi, Nadi Makkah Al-Adabi, Makkah pp61-62 have opened to alleviate the pressure, but they are not enough to cope with the large number of patients. The distances between this hospital and the districts it serves vary from 1km to 11km. Tall buildings surround it and just to its western side the wholesale food market is located, creating problems between traffic coming to the hospital and that coming to the market. The traffic includes heavy lorries transporting food to the market and trucks loading food to distribute to shops around the city, besides shoppers' vehicles and visitors to the hospital.

King Abdulaziz Hospital is in Al-Zahir district, approximately 6km to the west of the city centre. This hospital is located in a very highly populated district (45,000). In theory, its capacity can only cater for the inhabitants of Al-Zahir district. The hospital is sited on the busiest main street coming from Al-Medina. There is great conflict between the local traffic and that coming from Al-Medina expressway along this road.

King Faisal General Hospital is located north of Al-Haram area, in Al-Shisha district. The distance between this hospital and the city centre is approximately 6km. The hospital should be able to provide services for people who live in Al-Shisha, Al-Rudah and Al-Faisaliah districts. This hospital is also surrounded by tall buildings and highly populated areas. The main street coming from Mina passes to the east where the main hospital entrance is located. This street is extremely busy during Hajj.

Hera General Hospital is located north of Al-Haram, approximately 14km from the city centre. This hospital is the only one situated outside the built-up area. The highway between Makkah and Al-Medina passes nearby. Due to its specialist and out-patient clinics, this hospital is the destination for all the patients in the city who require treatment by highly qualified specialists. This factor keeps the streets and highways leading to it very busy most of the day, especially Al-Taneem street which carries traffic to Al-Medina and King Abdulaziz Hospital, and provides the only access for people coming to this hospital.

The Public Security Police Hospital is situated east of Al-Haram in Al-Aziziah district, about 9km from the city centre. It is estimated that this hospital can provide health care for people who live in Al-Aziziah, Mina, Al-Adel and Al-Khansa districts. However, this hospital was not designed to function like the other hospitals since it primarily provides health services for public security police members and secondly for any citizens who wish to attend it. Only seven doctors work here, which is not sufficient to provide a comprehensive service like the other general hospitals in the city [6]. Thus, this hospital is incapable of serving the people who live in Al-Aziziah district, placing greater strain on other hospitals.

In addition to the hospitals mentioned above, there are two privately owned and run hospitals which have already been mentioned. The first is the National Saudi Hospital which is in

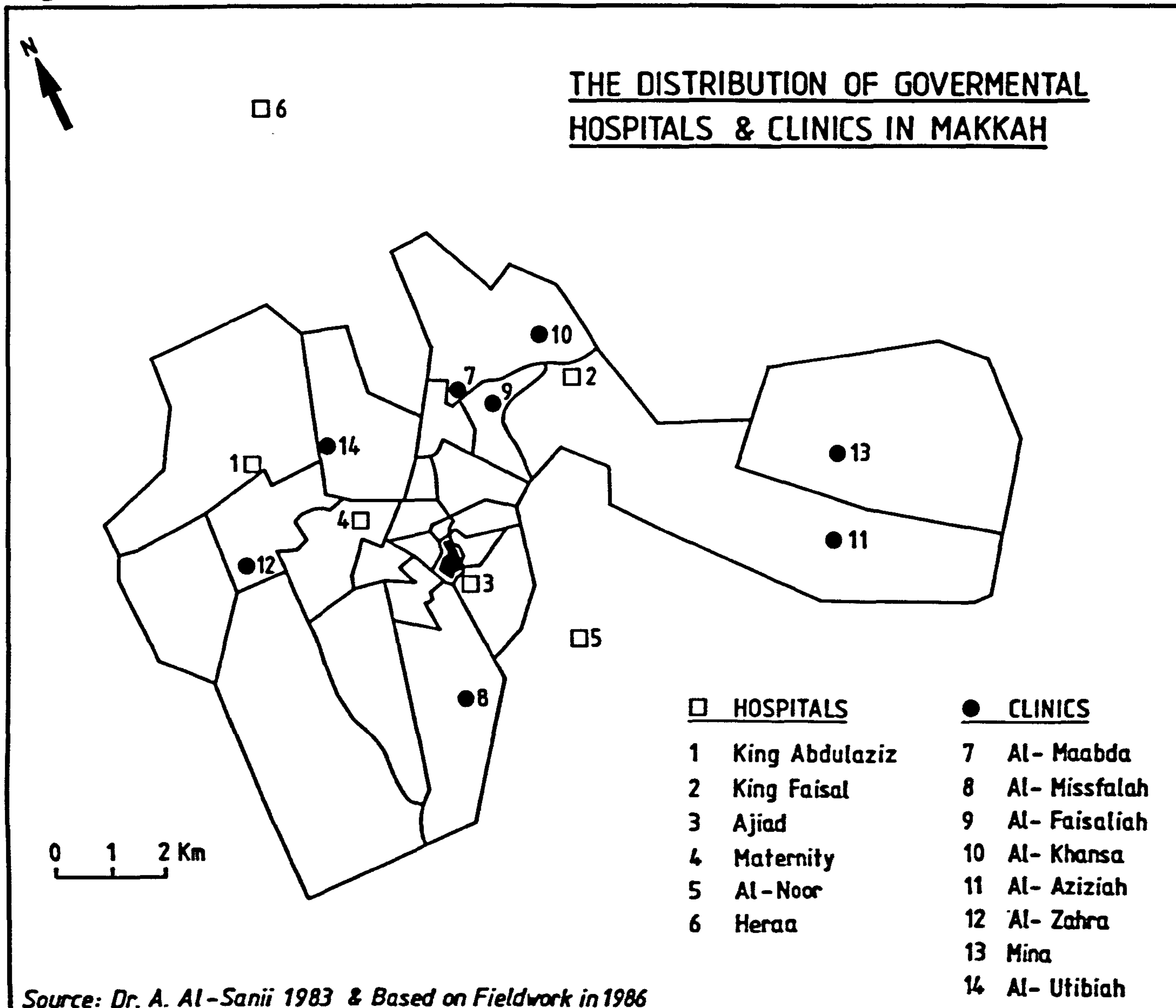
Al-Aziziah district, approximately 9km fom the city centre. This hospital is sited in a very busy residential area and nearly 150 metres from the main street. The streets around this hospital are narrow and very busy most of the day time, with residents' vehicles and hospital visitors.

The second hospital is Doctor Ahmed Zahir Hospital which is located in Al-Nuzha and surrounded by houses on all sides. This hospital is situated nearly 300 metres from the main street leading to old Jeddah road. Bus services do not extend as far as the hospital and patients therefore have to walk from the main street. The distance between this hospital and the city centre is nearly 8km.

With respect to the distribution of the health care units, both those under the direct management and control of the Ministry of Health and those privately owned and run, it is observed by Dr. Al-Sanii that their distribution is impractical for serving the city inhabitants (Fig. 7.1). Health care units are often situated in rented buildings which have not been designed for the purpose [7].

In connection with the private doctors' clinics and offices, their distribution tends to be clustered around the Al-Haram area and particularly on the main street from Al-Haram, which is busy with a large traffic volume for most of the day. The offices usually occupy flats in buildings around Al-Haram. These private doctors' clinics are not easily accessible since they are located amongst banks, commercial and government offices.

Fig.7.1


THE DISTRIBUTION OF GOVERMENTAL HOSPITALS & CLINICS IN MAKKAH
N
HOSPITALS
1 King Abdulaziz
2 King Faisal
3 Ajiad
4 Maternity
5 Al-Noor
6 Heraa
CLINICS
7 Al- Maabda
8 Al- Missfalah
9 Al- Faisaliah
10 Al- Khansa
11 Al- Aziziah
12 Al- Zahra
13 Mina
14 Al- Utibiah
0 1 2 Km
Source: Dr. A. Al-Sanii 1983 & Based on Fieldwork in 1986

From the foregoing discussion, it can be said that the distribution of hospitals and clinics leaves some recently established districts without health services. This results in generating many trips from these areas for health purposes. Since the five largest hospitals under the control and management of the Ministry of Health are each expected to cater for 40,000 out patients, they are kept extremely busy providing care for 95,000, well beyond their capacity (the total population being 600,000, as mentioned above).

Due to the fact that some districts are a great distance from the nearest hospital, there is little alternative to using private cars to transport patients, therefore increasing traffic volume. As already noted in Chapter 6, any form of transportation requires parking facilities at destination to be adequate. In general, this does not meet demand and motorists often have to park by the road. The adequacy or otherwise of street parking near hospitals and the attendant problems will be considered in the following sections, based on a field survey undertaken in 1985.

7.4 The Survey

In 1984, we made a documentary search in Makkah concerning car parking demand at hospitals and its problems. Our investigation revealed that there was no published data. As a result, we designed a survey with several objectives:

1 To ascertain the demand for street parking at hospitals.

2 To observe hourly variation in parking demand.

3 To note the way in which drivers park.

4 To study the effect of parking upon traffic flow in the streets in the vicinity of hospitals.

7.4.1 Survey Method

General, specialised and private hospitals were selected for inclusion in the survey, to achieve a representative result and specific recommendations. A road map was used to locate the selected hospitals in the city. Four government hospitals and a private one were chosen. The name of each appears in the survey results.

A meeting was held with the authority of each selected hospital to explain the purpose of the survey and to obtain permission to conduct the survey and to seek advice.

A random sample of on-street car park users was selected to answer questions concerning details about the journey to hospital. The interviewees were asked to fill out the questionnaires on the spot, in order to ensure their return. Interviewers were instructed to ask every fifth person waiting to be seen by the doctor. A brief explanation about the survey was given. Initially, interviews were attempted outside the hospital, but patients were concerned about missing their turn. The hot weather also caused a problem, so the survey was conducted indoors.

Interviews were carried out on four weekdays, from 07.00 to 19.00 hours. By covering 12 hours, it was possible to gain a complete picture of parking demand. Details requested were:

1 The arrival time at hospital, to ascertain the most significant peak.

2 Place of origin, to establish the most dominant districts generating (producing) trips to hospitals.

3 The travelling distance between origin and hospital location, in order to establish how frequently people come from different distances to the hospital.

4 Travelling time taken to accomplish the journey.

5 The mode of travel used.

Questions were also asked concerning car parking facilities, whether adequate, inadequate or non-existent. Distance between car park and hospital was ascertained in order to determine acceptable walking distance. Opinions were sought in relation to clarity of signs leading to hospital. Bus users were asked about difficulties encountered on their journey to hospital. This same was also requested of motorists. Finally, the interviewee was asked for comments to be taken into consideration when making recommendations. Altogether, 1,200 samples were distributed to hospital visitors (1%), divided equally between the selected hospitals.

After the survey, 800 completed sheets were returned. They were examined carefully and 600 were found to be valid. The remainder were incomplete or illegible. Some people did not answer the questions seriously or realistically and others could speak neither English nor Arabic, thus presenting an insuperable problem.

7.4.2 Survey Findings

The study revealed two distinct peaks, showing the flow of people travelling to the hospitals. The first peak is during the morning (56.2%). A second, lesser peak is in the evening (38%). The reason that the morning peak is the highest reflects longer working hours, usually from 08.00 to 13.00 hours. The evening peak is slightly less because it covers a shorter space of time, 17.00 to 19.30 hours. The flow of people between 13.00 and 16.00 was low because most of the specialist doctors and staff at hospitals go home at this time for dinner and a rest. Those attending between 13.00 and 16.00 (4%) usually came to the emergency department which is open 24 hours a day. Other results obtained from the survey are discussed in the following sections.

7.5 Journey to Hospital

There are two reasons for travelling to hospital. The first is to visit the doctor for treatment and medicine as required. The second is to visit a patient in the hospital. The focus of our survey was mainly confined to those who come to see the doctor. People who come to visit a patient do so only in the evening. Many of the hospital visitors came from Makkah.

7.5.1 Mode of Travel to Hospitals

The study revealed that the most popular mode of transport was the private car, whether owned by the patient or a friend. This accounted for 77.2% of all means of transport. This proportion is very high and significantly boosts the traffic volume on the city streets leading to hospitals, creating congestion. Public transport conveyed 12.7% and taxis 10.2% of patients. No one walked, due to the distance and discomfort. Why do people use their private cars to journey to hospital? The answer to this question will be the subject of the following sections.

7.5.2 Origins of Visitors

The aim of this section is to establish the nature of movement of visitors to hospitals in the city. Our assumption concerning movement is based on the location of the hospital and the districts around it. For instance, it is likely that patients will use the nearest hospital to their homes. The study revealed (Table 7.3) that this assumption is incorrect, since all hospitals in Makkah can expect patients from all districts of the city. So, why do people travel to far distant hospitals? This may be due to the differences in the level of care received. Sometimes, it is a matter of personal preference or the fact that one particular specialist has been recommended. Fig. 7.1 illustrates the distribution of hospitals and their location in

Table7.3 <u>Origins of Visitors to Hospitals</u>
Source: Fieldwork, Makkah 1985

Origin districts	Hospitals						
	Hara	Ajiad	King Abdulaziz	King Faisal	National Hospital	Raw Total	%
Amir Path	-	-	4	6	1	11	1.8
Al-Qushashiah	-	-	1	2	1	4	0.7
Ajiad	1	8	1	-	6	16	2.7
Al-Missfalah	1	5	2	4	9	21	3.5
Al-Tundbawii	3	2	5	4	5	19	3.2
Al-Hindawiah	1	3	-	-	2	6	1.0
Al-Shabikah	-	3	-	-	1	4	0.7
Harat Al-Bab	-	5	-	1	-	6	1.0
Jarwal	1	2	12	2	6	23	3.8
Al-Zahra	1	-	3	-	3	7	1.2
Al-Nuzha	3	2	6	-	3	14	2.3
Al-Zahir	6	3	21	2	5	37	6.2
Al-Utaibiah	2	2	11	11	8	34	5.7
Al-Sullimaniah	-	-	1	3	1	5	0.8
Al-Shamiah	1	1	-	-	-	2	0.3
Al-Jamizah	-	1	-	3	4	8	1.3
Al-Maabdah	5	2	4	25	27	63	10.5
Al-Khansa	-	1	2	13	6	22	3.7
Al-Aziziah	2	12	29	48	78	169	28.2
Mina -	-	-	-	5	3	8	1.3
Kudi	-	5	-	-	-	5	0.8
Al-Rassifah	1	3	7	3	6	20	3.3
Al-Shishah	-	1	2	17	10	30	5.0
Al-Rudah	1	-	-	2	2	5	0.8
Al-Adel	-	-	-	-	1	1	0.2
Al-Gasshalah	1	-	1	8	-	10	1.7
Jabal Al-Noor	-	-	-	5	4	9	1.5
Al-Hajj Street	1	-	2	-	2	5	0.8
Al-Faisaliah	-	-	1	1	1	3	0.5
Al-Taniim	4	-	7	1	-	12	2.0
Arafat -	-	-	-	1	1	2	0.3
Al-Shanaii	-	-	-	10	3	13	2.2
Jeddah	-	1	-	-	-	1	0.2
Taif	-	-	-	-	1	1	0.2
Fatmah Valley	-	-	3	1	-	4	0.7
Total	35	62	125	178	200	600	100

relation to the districts. From this, it can be seen that their siting does not provide uniform care throughout the city. Thus it is not surprising to find hospitals with patients from several districts; nor inhabitants of one area travelling to different hospitals for reasons other than specific patient care. From Table 7.3 it can be seen that people from some districts require hospital treatment more frequently than those in others, reflecting the high density of population in certain areas. The Table also shows that the government hospitals attract more patients (66.7%) due to the fact that the Kingdom of Saudi Arabia provides a free public health service [8] for everyone. Catering for people living outside the city must add to traffic volume, as shown in Fig. 7.2.

Referring to Fig. 7.1, it can be seen that the hospitals and clinics are more than a 10 minute walk away from the districts which they serve. Thus, private cars, buses and taxis are necessary. The distance and length of travelling time will be considered in the next section.

7.5.3 Distance of Journey to Hospital and Travelling Time

The distance between hospitals and homes of patients varies from less than 1km to more than 10km, and travelling time from 10 minutes to 60 minutes. There is a very positive correlation (0.63) between the distance and the travelling time taken to reach hospital. Travelling time varies in direct relation to distance so that the greater the distance, the longer the

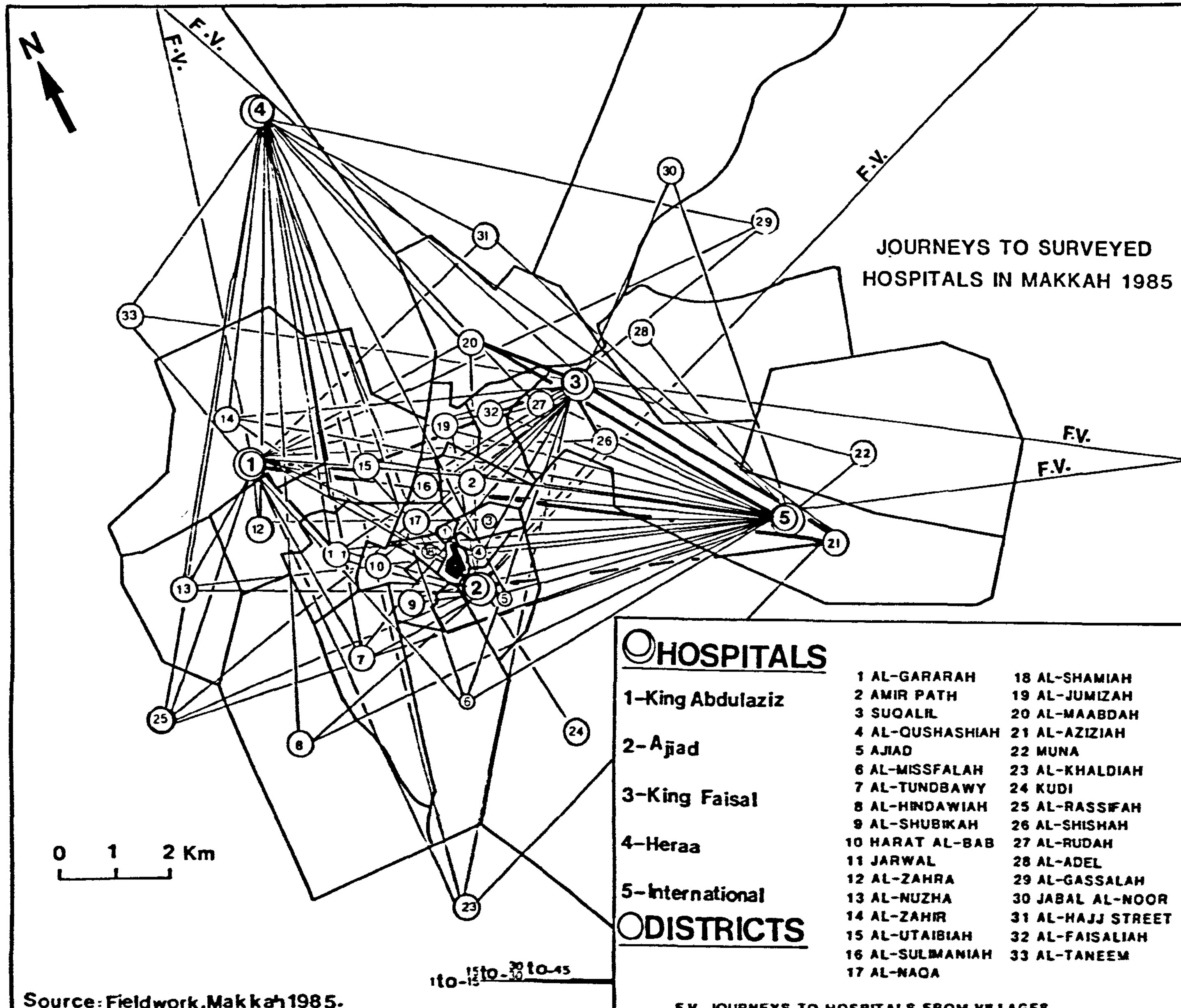

JOURNEYS TO SURVEYED HOSPITALS IN MAKKAH 1985
N
F.V.
0 1 2 Km
HOSPITALS
1-King Abdulaziz
2-Ajiad
3-King Faisal
4-Heraa
5-International
DISTRICTS
1 AL-GARARAH
2 AMIR PATH
3 SUQALIL
4 AL-QUSHASHIAH
5 AJIAD
6 AL-MISSFALAH
7 AL-TUNDBAWY
8 AL-HINDAWIAH
9 AL-SHUBIKAH
10 HARAT AL-BAB
11 JARWAL
12 AL-ZAHRA
13 AL-NUZHA
14 AL-ZAHIR
15 AL-UTAIBIAH
16 AL-SULIMANIAH
17 AL-NAQA
18 AL-SHAMIAH
19 AL-JUMIZAH
20 AL-MAABDAH
21 AL-AZIZIAH
22 MUNA
23 AL-KHALDIAH
24 KUDI
25 AL-RASSIFAH
26 AL-SHISHAH
27 AL-RUDAH
28 AL-ADEL
29 AL-GASSALAH
30 JABAL AL-NOOR
31 AL-HAJJ STREET
32 AL-FAISALIAH
33 AL-TANEEM
F.V. JOURNEYS TO HOSPITALS FROM VILLAGES
Source: Fieldwork, Makkah 1985.

Fig.7.2

travelling time (Fig. 7.3). To cover a distance of 10km takes 45-50 minutes. This seems unusually long, but may be explained by the fact of travelling through built up areas, since it takes only the same amount of time to travel between Makkah and Jeddah.

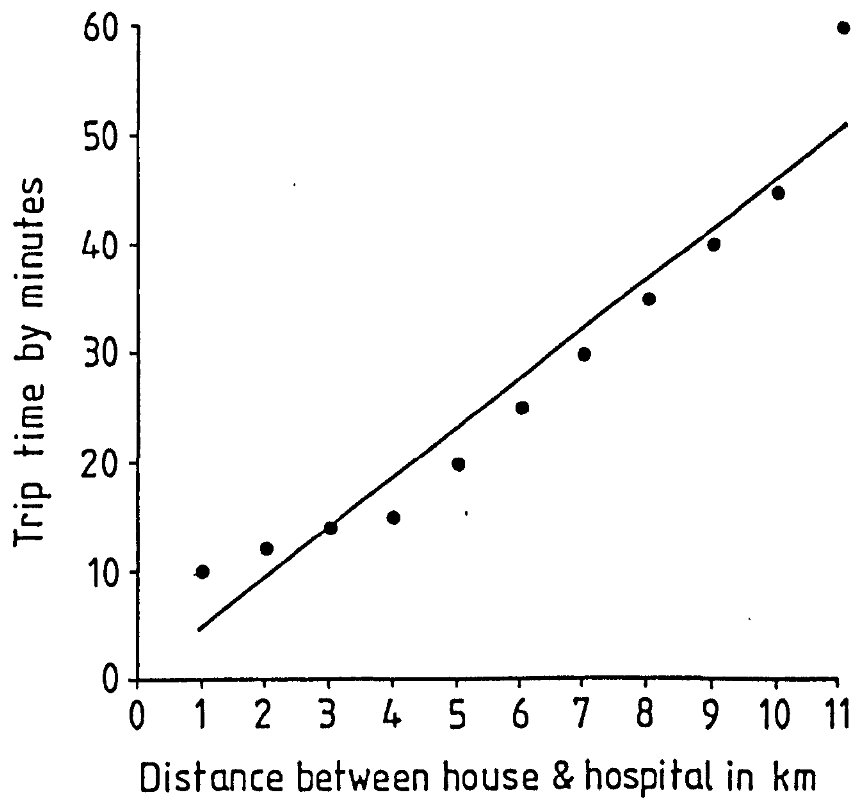
From Table 7.3 it can be seen that the number of visitors varies according to distance, but this may be coincidental. It may be that fewer patients requiring treatment on one particular day come from further away, but the statistic must also relate to the density of different residential areas.

7.6 Evaluation of Journeys to Hospital

> It is most important to make distinction between 'place' accessibility and 'people' accessibility (9).

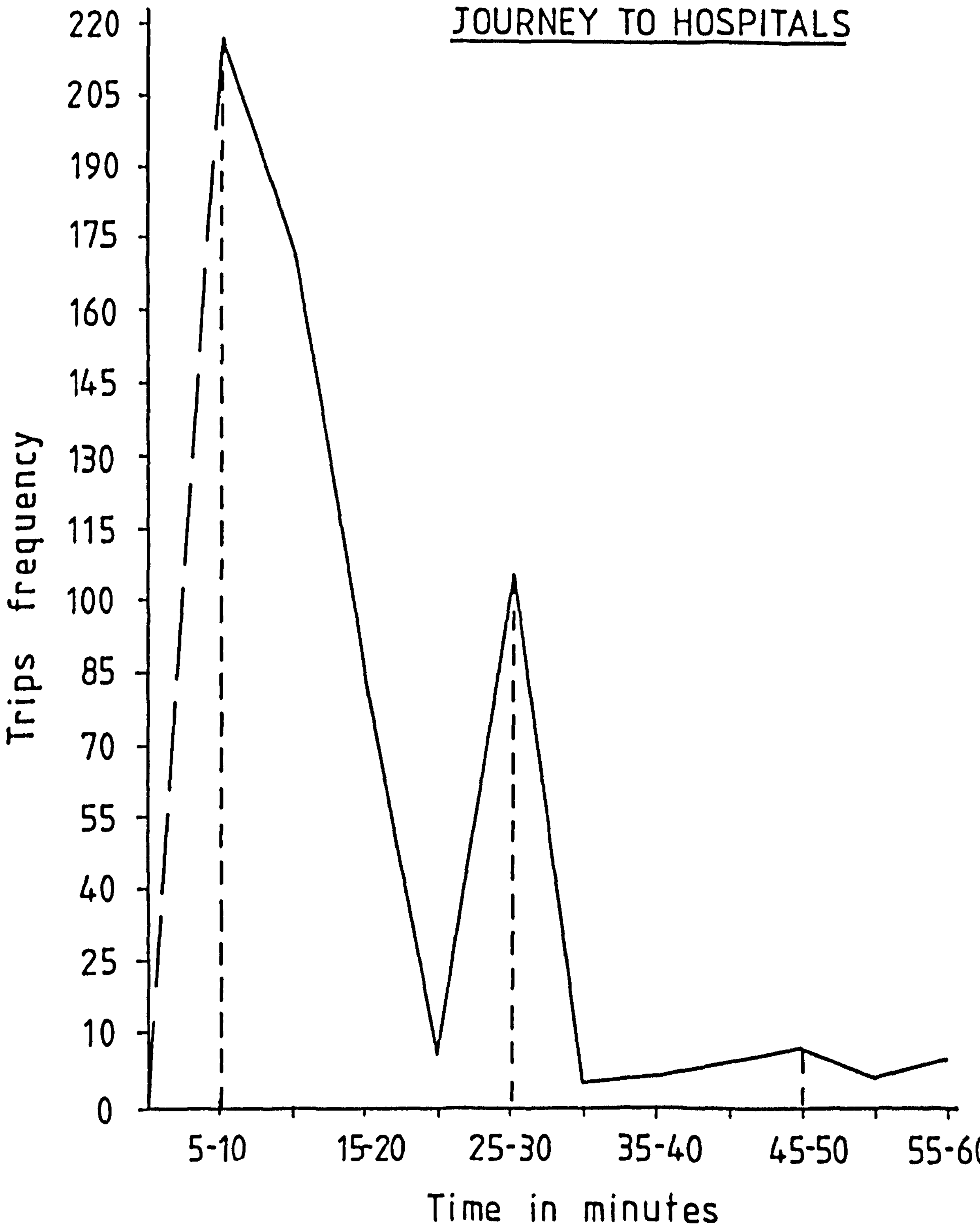
The purpose of this section is to establish how easy or difficult it is to get from various districts of the city to hospitals. If the traffic system control and managment is effective, drivers have the opportunity to reach their destination in reasonable time. Additionally, the quality of the network can effectively influence easy access to any centre in the city. Referring to Fig. 7.4, it is noticed that most journeys can be accomplished within 10-30 minutes, which is deemed reasonable. However, accessibility is not uniform in its distribution. Table 7.4 shows that 5% of trips took longer than 30 minutes. Although some of the journeys were from outside the city, they accounted for only 21, therefore some of the trips within the city must have been lengthy. Clearly, in the latter

Fig.7.3 RELATION OF TIME & DISTANCE



SOURCE. FIELD WORK, 1985, MAKKAH, SAUDI ARABIA

Fig.7.4 THE TIME TAKEN TO FINISH THE JOURNEY TO HOSPITALS



SOURCE. FIELD WORK MAKKAH 1985

case, there must have been obstructions. As a result of the 1985 survey, it was discovered that various difficulties were encountered, affecting the accessibility of hospitals and these will be discussed subsequently.

Table 7.4 Time Taken to Reach Hospitals in Makkah

Travel Time (minutes)	Frequency	%
5 - 10	215	35.8
10 - 15	168	28.0
15 - 20	76	12.6
20 - 25	7	1.2
25 - 30	105	17.5
30 - 35	2	0.3
35 - 40	3	0.5
40 - 45	6	1.1
45 - 50	8	1.4
50 - 55	4	0.7
55 - 60	6	1.0
Total	600	100.0

Source: Fieldwork Makkah, 1985

Table 7.5 reveals that 39.7% of people travelling to hospitals found the journey easy. This may be due to short distances or lack of traffic volume. However, the majority (60.3%) found the journey difficult. Common difficulties were road works and potholes on the route. These factors necessitate reduction in speed, thereby lengthening travelling time.

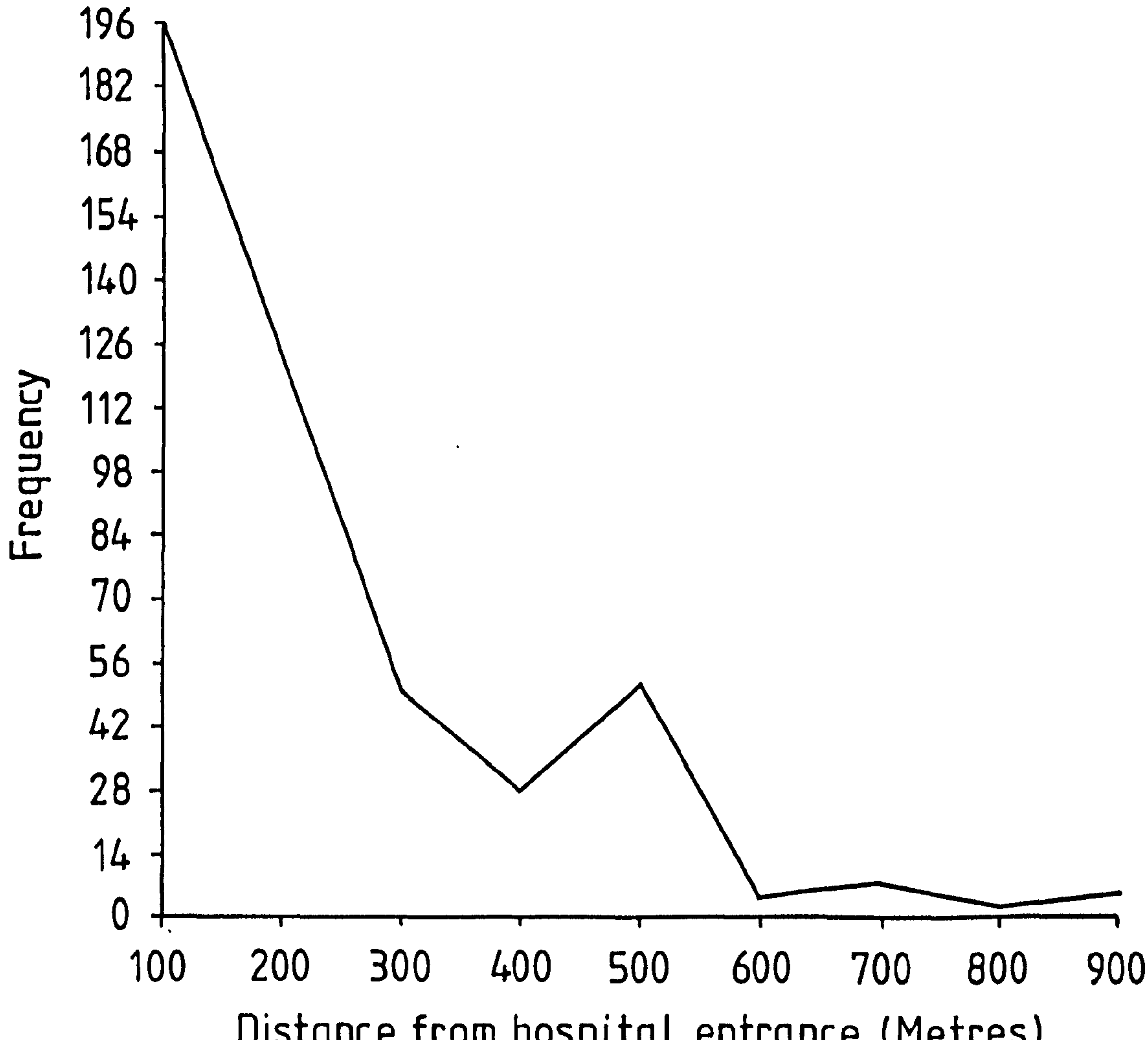
Numerous traffic lights also cause delays. If there are 10 sets of traffic lights and the stopping time at each is one minute, a motorist can add 10 minutes to his journey. However, more significant are the difficulties resulting from heavy traffic. People visiting hospitals invariably face this problem, because most of the hospitals are located on streets which carry a large volume of traffic. For example, Al-Taniim street which passes the eastern side of King Abdulaziz Hospital in Al-Zahir district carries traffic to and from Al-Medina and is an extremely busy road. The other street passing the hospital from the southern side is Qassar Al-Diafa street, carrying traffic to and from Jeddah. As these two streets are very important in providing access to and from other cities and to and from the King Abdulaziz Hospital, a large traffic volume can be expected. There are no alternative routes which may be used to alleviate the congestion. The same difficulty faces people attending Hera Hospital, where there is only one means of access via Al-Taniim street. This route is busy most of the time, carrying vehicles travelling to Al-Medina, King Abdulaziz Hospital and the new residential areas at Al-Taniim and Al-Nawariah, north of the

Table7.5 Ease of Journey to Hospital

Difficulties Obtained From Survey	Frequency	%
Those who found the journey easy	238	39.7
Those who found the journey difficult for the following reasons:		
Potholes in road	31	5.2
Long distance	15	2.5
Numerous traffic lights	57	9.5
Heavy traffic	171	28.5
Narrow streets	11	1.8
Long delay for taxi	16	2.7
Numerous detours	14	2.3
Difficulty of access	18	3.0
Interruption by pedestrians	9	1.5
No zebra crossings	19	3.2
Speeding drivers	1	0.1
Total	600	100.0

Source: Fieldwork Makkah, 1985

Fig. 7·5 PARKING DISTANCE FROM HOSPITALS



SOURCE. FIELD WORK, MAKKAH 1985

city. Narrow streets compound the problem. For example, the National Hospital at Al-Aziziah district is located in the middle of a built-up area, where streets in the vicinity of the hospital are only 10 metres wide. They cannot meet the increasing traffic demand of vehicles travelling to the hospital. The traffic flow one way is impeded by parked cars or two-way traffic. The general car parking problem in residential areas has already been discussed in Chapter 6.

Access to hospitals was affected by numerous detours. These cause great inconvenience to drivers unfamiliar with the city. Pedestrians crossing the roads slow the traffic flow, sometimes causing it to stop suddenly, since there are no zebra crossings. Drivers complained about this. Problems are also created for patients travelling on buses, who have to cross busy roads to reach the hospitals.

It is apparent from the foregoing that patients face considerable difficulties in travelling to hospitals. One of the obvious difficulties is the heavy traffic on routes leading to hospitals, which may lose the patient vital time in an urgent case. This problem, and some others which appear in Table 7.5, require immediate relief action as present hospitals are few and far between.

7.7 Car Parking Demand

Terminal facilities are an integral part of any transportation system, and road transportation is no exception. Traffic is not usually generated for the sake of movement. It travels towards a destination and, having arrived there, the vehicle must be parked whilst some business, whether private, public, recreational, or servicing, is transacted. Failure to supply suitable terminal facilities for the expected and allowable demands results in congestion and frustration. This eventually leads to the decline in importance of those areas at present considered most desirable for the day-to-day business of the city and its inhabitants, unless alternative and adequate travel facilities are provided. Generally, increases in vehicle ownership result in increased parking demand. In the United Kingdom, as in other developed countries, the increase in demand is posing a major problem for which ready solutions are not available. Without a knowledge of the demands, solutions cannot be proposed (10).

As hospitals in Makkah are one of the most important foci, so plenty of journeys may be expected to be generated by them. The increase of car ownership in the city and the intensive use of vehicles has grown as the city itself has expanded spatially. In the early part of this Chapter, it was noticed that the private car is the dominant means of transportation to hospitals. Having arrived at the destination, vehicles must be parked, whilst patients consult the doctors, as well as staff working in the hospital and those visiting bed-patients in the evening.

When interviewing visitors to hospitals in 1985, one of the queries concerned the adequacy of parking facilities. 7.1% of all visitors considered facilities to be adequate; 25.2% deemed them inadequate; and 67.2% claimed car parking to be non-existent. From these results, it would appear that some hospitals have car parking facilities, while the rest do not (Table 7.6). The only hospital with proper facilities is the National Hospital at Al-Aziziah (Plate 7.1). Yet, even these are inadequate since there is capacity for only 50 vehicles. The car parking area, used by both patients and staff, is the only space available for this purpose, and was created by the hospital authorities (11). Since the capacity of this car park is very small in relation to requirement, this has resulted in parking in nearby streets (Plate 7.2), causing congestion. On the other hand, no other hospitals in Makkah have car parks at all, so vehicles have to be street parked. Not enough attention has been paid to this problem by city planners or hospital architects, although the demand for hospital car parking has long posed a problem.

Table 7.6 The Adequacy of Hopsital Car Parking Facilities

Car park Facilities	Hospitals: A	B	C	D	E	Row total	%
Adequate	-	-	-	-	-	46	7.6
Inadequate	2	1	1	1	146	151	25.2
Non-existent	33	61	124	177	8	403	67.2
Total	35	62	125	178	200	600	100.0
%	5.8	10.3	20.8	29.7	33.3		

Hospitals: A = Hara; B = Ajiad; C = King Abdulaziz;
D = King Faisal; E = National

Source: Fieldwork, Makkah 1985

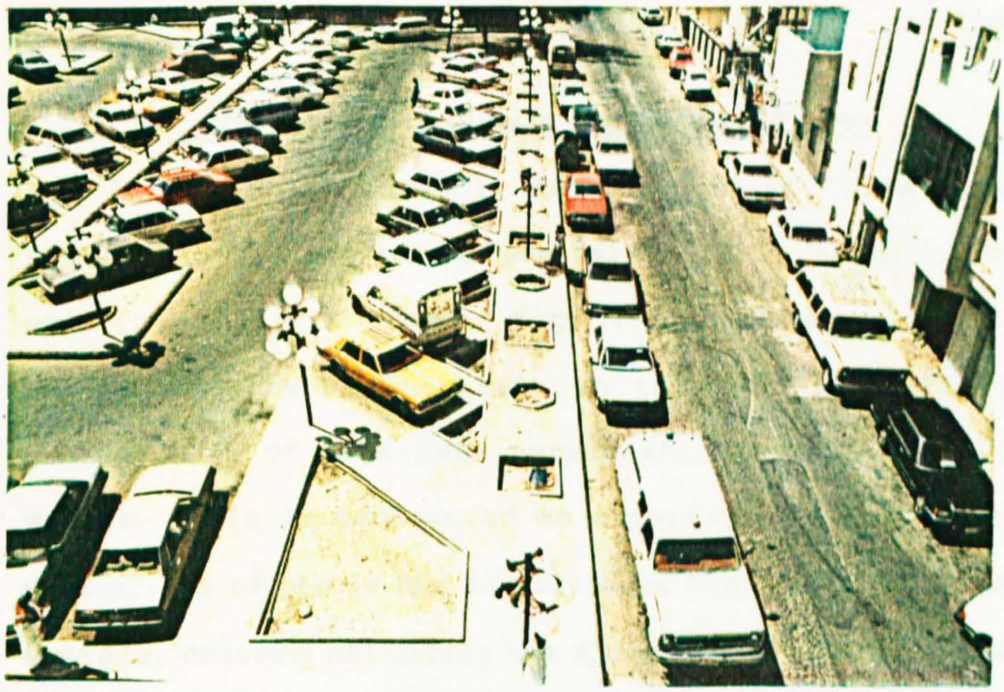


Plate 7.1   Open air car park at the national hospital, Al-Aziziah District, June 1985. (Photo: Z.A. Mekki, 1985.)

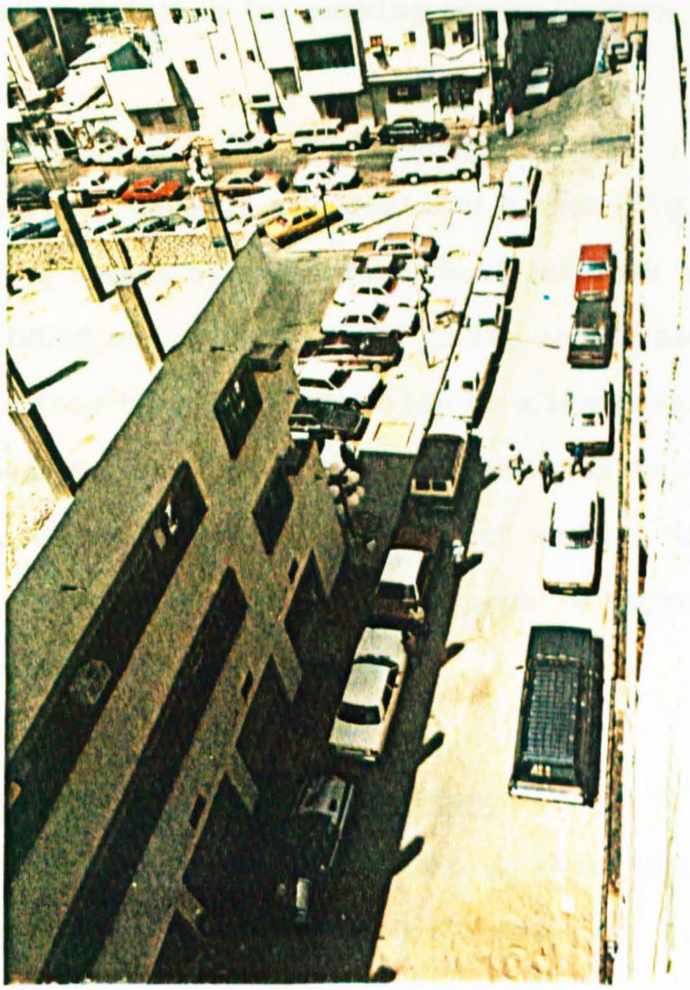


Plate 7.2   Streets around national hospital used for car parking when the hospital car park is full, June 1985. (Photo: Z.A. Mekki, 1985.)

7.7.1 Distance Between Hospitals and Parking Places

It is seldom possible for a motorist to park his car immediately adjacent to the hospital building. Normally, he must walk from a street nearby. Fig. 7.5 shows the accumulation of parked vehicles at hospitals in relation to distance. In general, 96% of cars were parked at distances from 100-500 metres. This is considered an acceptable walking distance. However, 4% of people had to walk more than 500-900 metres. For example, drivers attending the Ajiad Hospital face tremendous problems, often having to drive round to find somewhere to park, since the hospital is situated in a residential and commercial area, and competition for parking spaces is keen.

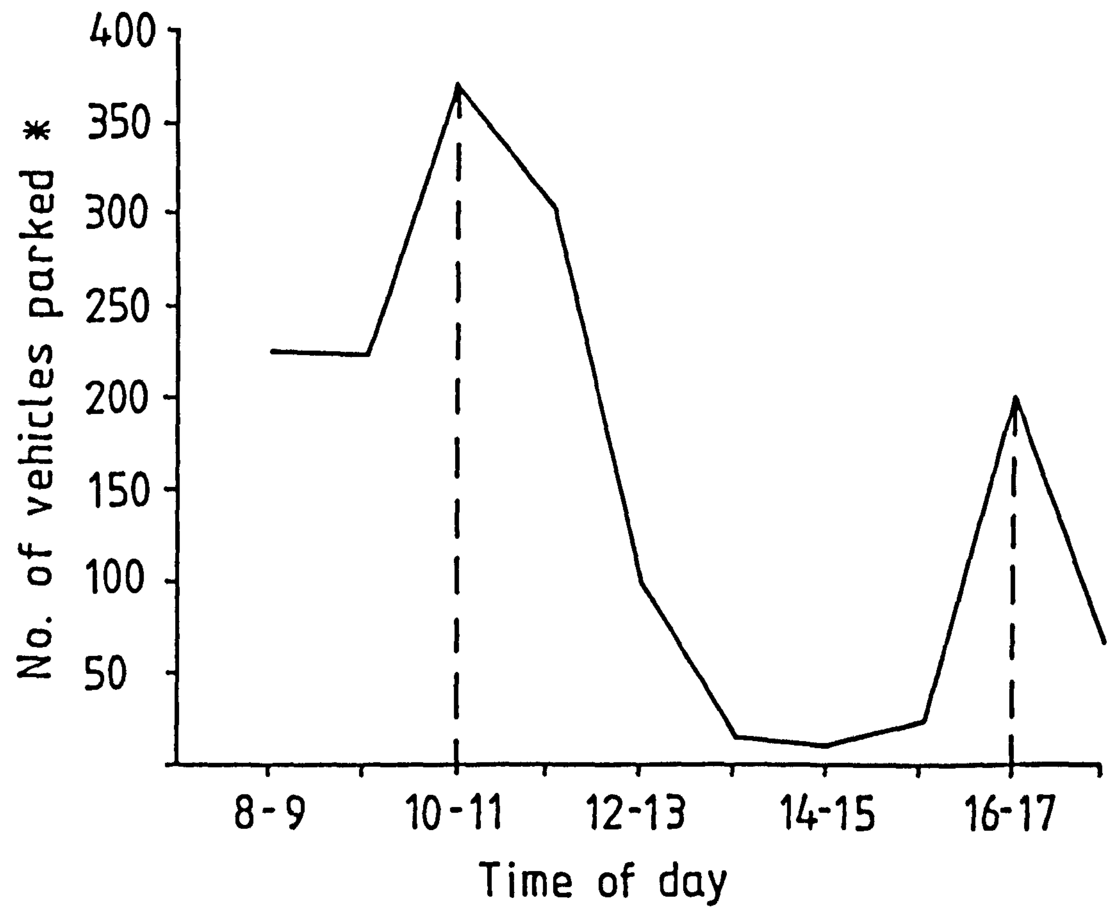
7.7.2 The Hourly Car Parking Variation

The study reveals two distinct peaks (Fig. 7.6) in demand for parking spaces by patients. The first peak started to build up from 08.00 and rose steadily to its zenith between 10.00 and 11.00 and from then fell gradually to a low level at 14.00. The second peak began at 16.00 and rose gradually to reach its zenith at 17.00, then fell again at the end of working hours at the out-patient department. The morning peak is significantly higher, due to reasons already discussed.

7.7.3 Average Daily Car Parking Demand

In addition to the above section about hourly variation, there should be another, showing the daily car parking demand at

Fig.7.6 CAR PARKING DEMAND VARIATION ACCORDING TO TIME



SOURCE. FIELD WORK 1987 MAKKAH SAUDI ARABIA

* NOTE: THESE FIGURES ONLY REPRESENT VEHICLES PARKED AT KING ABDULAZIZ HOSPITAL.

hospitals, in order to establish daily variation. Unfortunately, this was impossible due to lack of manpower and time to carry out the survey. Nevertheless, a rough estimate may be made, based on the average daily number of visitors and the proportion of these using private cars. In this way, a calculation may be made to ascertain the parking space required at hospitals in order to meet daily parking demand. The average was based on the data available for 1982 and the percentage of the hospital visitors using their cars was based on the result of the 1985 survey. The number of people using Ministry of Health hospitals in 1982 was 3,601,027 [12]. The daily average for each hospital is thus 1,668. Since those travelling by private cars constituted 77.2%, it can be estimated that the daily number of parked vehicles at each hospital is approximately 1,290. This figure is slightly less than that obtained for parked vehicles at King Abdulaziz Hospital for one day (10 June 1987). However, this number (1,533) cannot be taken as an average for all hospitals.

From the average number of cars obtained from the crude estimate, it is possible to calculate the area needed to cater for parking at hospitals during every hour of the day. Thus,

Daily area needed = Average daily number of cars x ($14m^2$) [13]

Area needed every hour = $\frac{R}{N}$

where R = the area needed for daily parking;

N = the working hours at hospitals.

(These formulae were devised by the author.) From the second formula, it can be said that the area needed to be used on streets at each hospital is 2,000m^2/hour.

7.7.4 Method of Parking

There is no system of parking and no lines define parking spaces. Near hospitals, drivers mostly park at the kerb side if spaces are available. Motorists obviously endeavour to park as near to the hospital buildings as possible, but during peak periods the competition for spaces is intense. Careless parking often results in one car taking up the space of two (Plate 7.3). Due to the absence of lines defining parking spaces, drivers often park in a haphazard and inefficient manner. As a result of the 1985 survey and walking round hospitals, various methods of parking were observed. The first method is parking parallel to the kerb, and the second parking at an angle (30°, 45°, 60° and 90°) to it. This latter method is adopted without consideration of the street width or space between one car and another. Yet another method is double parking and this occurs most often in streets closest to the hospitals, thereby causing congestion. The motorist does not hesitate to block other cars in his concern to park as near as possible (Plate 7.4). Clearly, this last method creates problems for owners of parked cars, sometimes leaving them no alternative but to wait for the offending driver. In addition to that the accommodation of parked vehicles near to the gate of hospitals creates access difficulties for ambulances.

Plate 7.3 One car taking up enough space for two at the King Abdulaziz hospital. Cars are also parked at odd angles, thus wasting space. (Photo: Z.A. Mekki, 1985.)

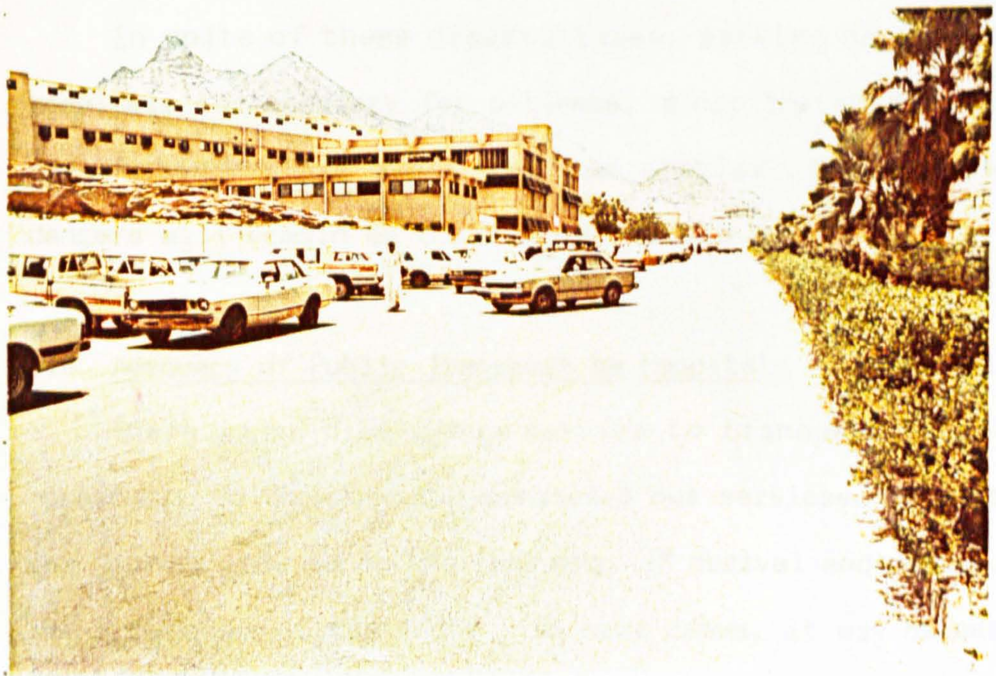


Plate 7.4 Blocking parking at King Faisal hospital, June 1985. (Photo: Z.A. Mekki, 1985.)

7.7.5 Parking Methods and Traffic Flow

The method of parking on streets round hospitals can create serious trouble for both motorists and the traffic flow. One of the common hazards caused by drivers parking is the habit of turning without checking whether there is a car behind. Also, a motorist leaving the parking place without due care may cause an accident with passing cars. Traffic speeds are reduced by more than 20% [14], due to cars parked along the kerbside. The capacity of streets around hospitals is also markedly reduced (Plates 7.5 and 7.6). This is because:

> a 20m wide street, with parking on both sides, has the same capacity as a 12m street where parking is prohibited, thus representing a loss in effective width of over 4m for each line of parked vehicles. This figure is considerably in excess of the width of standing vehicles [15].

In spite of these disadvantages, parking on streets near hospitals is necessary for patients, since there is no suitable alternative. This means that the problem of parking and its dangers will remain as there is no solution.

7.8 Adequacy of Public Transport to Hospitals

There is no dial-a-bus service to transport patients to hospitals, so they use the scheduled bus services. The speed of the journey depends on the frequency of arrival and departure and the directness of the route. In some cases, it may be necessary to change twice, thereby incurring three fares. In general, the bus services to the hospitals arrive every 45 minutes, which can result in much wasted time for the passengers. This can often

Plate 7.5 Double-parking on streets and its effects on traffic flow at Jaid hospital, June 1985. (Photo: Z.A. Mekki, 1985.)

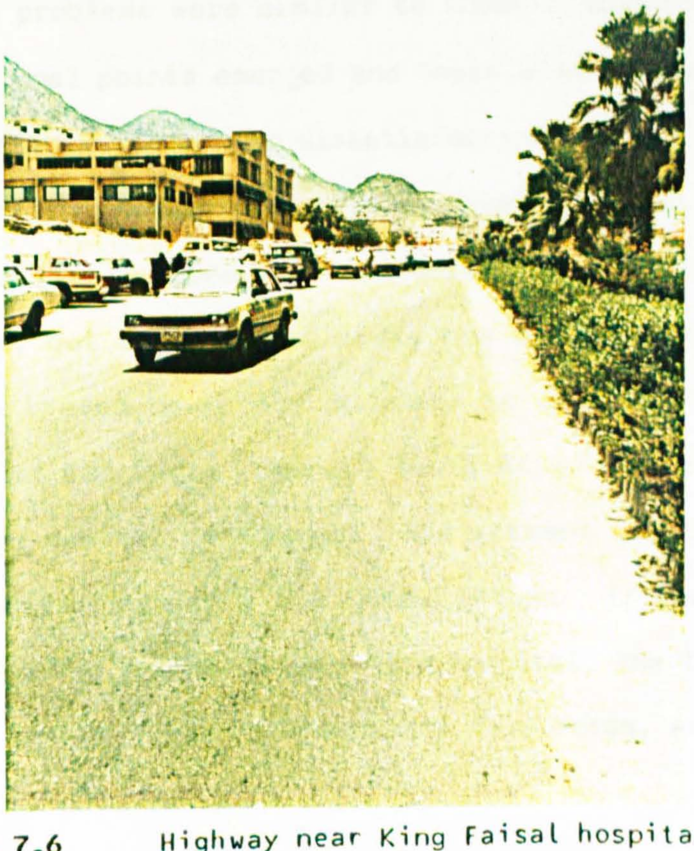


Plate 7.6 Highway near King Faisal hospital: traffic flow is hampered by intensive car parking. (Photo: Z.A. Mekki, 1985.)

encourage a traveller to take a taxi, thereby detracting from public bus revenues. The adequacy of bus services provided by SAPTCO from which people going to hospital benefit can be evaluated by the passenger himself. Our study revealed that more than two-thirds of bus passengers travelling to hospital were satisfied with the service. Therefore, a third considered the public bus service to be inadequate, which might affect their decision concerning the mode of transport in the future. Since public transport is the main option for those who do not own cars, reasons for dissatisfaction with it will be discussed in the next section.

7.8.1 Problems Facing Bus Passengers

Some problems were similar to those discussed in Chapter 4, but additional points emerged and these will be discussed here.

One common reason for dissatisfaction was the infrequency of bus services. Passengers also complained about the length of travelling time. Buses must obviously follow a fixed timetable and route, but stopping at every bus stop increases the time taken to travel what may already be a long distance. The increase of bus fares from one Saudi Riyal to two Saudi Riyals (1983) was another grievance. The present level of bus fares considerably affects the low income groups. If two buses have to be used for the journey to and from hospital, the total cost will be eight Riyals. This is below most taxi fares, since the single journey is likely to cost 15 Riyals, almost double the return bus fare. However, the taxi is more convenient, saves travelling time and goes right to the hospital. The cost of travelling by bus or taxi is greater than by car, due to the low fuel price. The possibility of buying a cheap second hand car or a new one by means of instalments has boosted car ownership. If all citizens managed to own their own vehicles, public transport would become unimportant and the roads would carry an even greater volume of traffic. By providing an adequate bus service at reasonable prices, the spread of car ownership might be impeded, thereby limiting the associated problems of congestion, delay, accidents and pollution.

7.9 Conclusion and Recommendations

It is apparent from the foregoing that the distribution of hospitals and the growth of the city both play a significant part in influencing the distance between districts and location of hospitals. This distance can vary from less than 1km to 11km. The distance factor (variable) itself plays a significant role in encouraging the use of a fast means of transportation. The most popular mode of travel is by means of the private car, as demonstrated in the previous discussion. So, why do people depend on private cars more than other means of transportation? Here, a comparison is made between car and bus travel. The car provides door-to-door service, with minimum delay and maximum convenience. The bus does not provide a door-to-door service and passengers must walk from their homes to the nearest bus stop, which may prove difficult for someone who is ill. Having arrived at the bus stop, he then has to wait for a bus, which must follow a fixed schedule and route, increasing travelling time. There is often a long walk from the bus stop to the hospital at the end of the journey. This is the situation in the case of Dr. Ahmad Zahir Hospital in Al-Nuzha district and the National Hospital in Al-Aziziah district (see Fig. 7.7). This occurs particularly when the hospital is far from the main streets. However, the use of private cars has some disadvantages, notably the heavy flow of traffic on the city network and the great demand for parking spaces. The absence of adequate parking facilities results in great pressure on streets around the hospitals (see Fig. 7.7) creating major difficulties for traffic flow. The problem of parking will become worse in the future as the city population grows and car ownership rises. However, some tentative recommendations can be made to relieve the problem.

In order to restrict traffic flow to hospitals, it is recommended that neighbourhood clinics be expanded, thereby reducing the number of patients using the hospitals. These surgeries could cater for basic health needs. They should be distributed throughout the city, according to population, so that no one has to walk for more than about 10 minutes to attend one. Even were cars to be used, they would be kept away from the main city area.

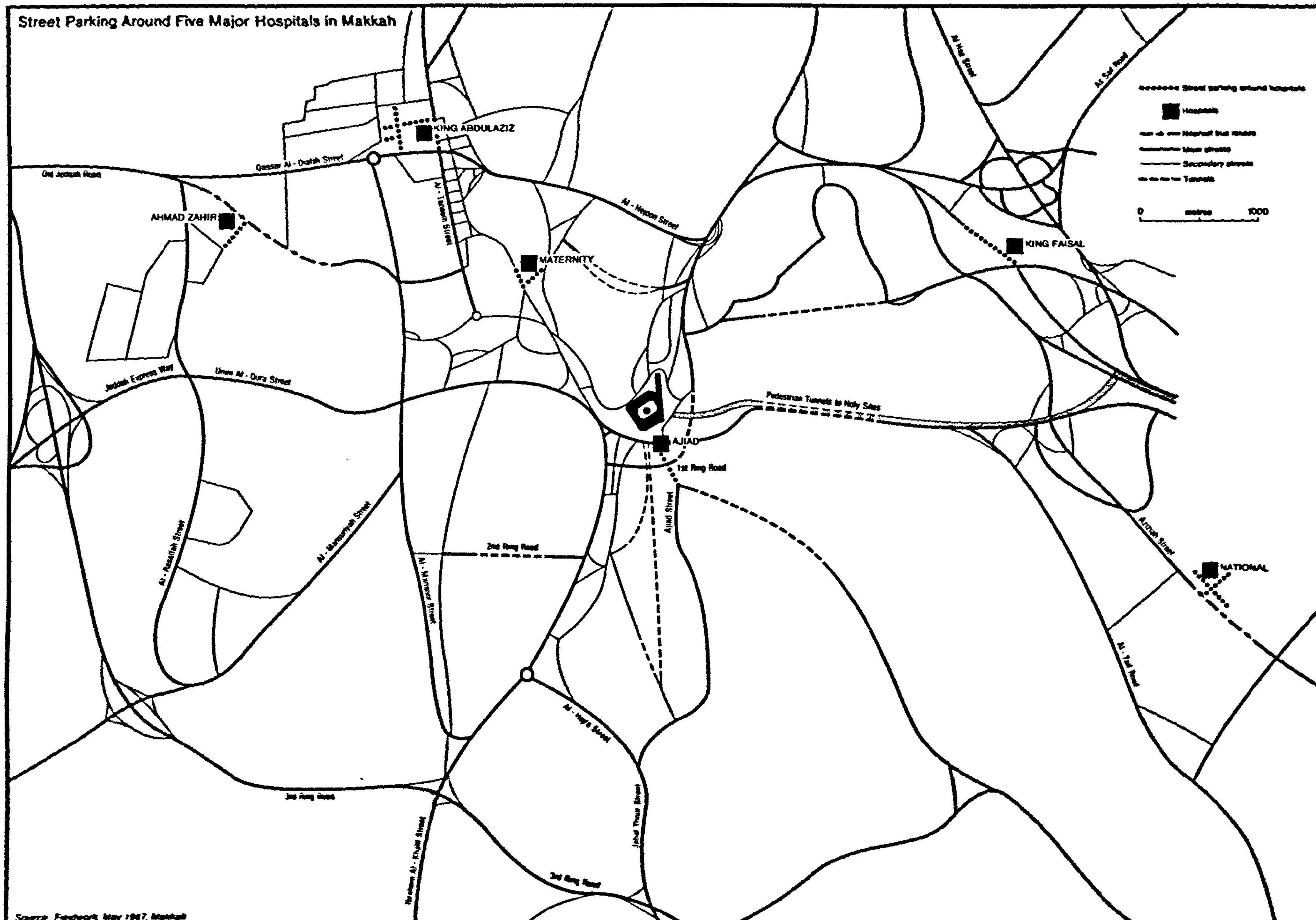

Street Parking Around Five Major Hospitals in Makkah
Hospitals
Main streets
Secondary streets
Tunnels
0
metres
1000
KING ABDULAZIZ
AHMAD ZAHIR
MATERNITY
KING FAISAL
AJIAD
NATIONAL
Qassar Al - Diafah Street
Old Jeddah Road
Al - Taneem Street
Al - Hejoon Street
Al Haj Street
At Taif Road
Jeddah Express Way
Umm Al - Qura Street
Pedestrian Tunnels to Holy Sites
1st Ring Road
Ajiad Street
2nd Ring Road
Al - Mansoor Street
Al - Mansuriyah Street
Al - Rasaifah Street
Al - Hajj's Street
Arzrah Street
Al - Taif Road
3rd Ring Road
Jabal Thour Street
Ibrahim Al - Khalil Street
Source: Fieldwork, May 1987, Makkah

Fig.7.7

A system could be evolved whereby people are required to register at the nearest clinic to their homes. In this case, a patient would only attend a hospital when referred by the clinic doctor.

Most general and specialised hospitals will still be needed to meet long-range development requirements. Cars will still have to be used to travel between the districts and the hospitals, so adequate parking facilities are necesary in order to prevent street parking problems. The city planners and hospital architects should decide the type of car parking facilities required by each hospital already in use. For example, a multi-storey car park could be built where the land use is already intensive, or a surface car park where space allows. Car parking facilities must be within acceptable walking distance and close enough to the hospital buildings to avoid the sun's heat by providing direct pedestrian access between the car park and hospital. Traffic police should be on duty to prevent illegal parking.

A temporary solution to the parking problem would be the introduction of lines on the ground to define parking spaces, and drivers must park accordingly. Since on-street parking still has to be used around hospitals at present, it is suggested that these roads be made one-way and cars allowed to park on both sides.

When building new city hospitals, they should be located away from main regional roads. There should be health units in villages in order to save travelling time and ease congestion in city streets. The public bus company should also improve its services.

Were the above recommendations taken into consideration, the problem of heavy traffic flow would be alleviated and the car parking problem would diminish. Also, the existence of surgeries in districts would help to contribute positively towards the control of traffic flow, making it more localised and easily manageable.

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11 Data provided by the Chief Administration of National Hospital, 1985. Fieldwork, Makkah.

12 Ministry of Finance and National Economy 1983. Statistical Yearbook, 19th Issue, Central Department of Statistics, Riyadh, Saudi Arabia, Tables 3-19

13 The size of the average parking space is about $14m^2$, obtained from

Brierly, J., 1972. <u>Parking of Motor Vehicles</u>, Applied Science Publishers Ltd., Essex, England p6

14 Salem, M.T., 1985, p302

15 Hobbs, F.D., 1984, pp190-191

CHAPTER 8

SHOPPING CENTRES AND CAR PARKING

8.1 Introduction

This Chapter confines discussion of shopping centres to the question of location and distribution in relation to access by shoppers. The mobility of shoppers and their motives and behaviour in moving between markets in the city are also discussed. The movement of people within Makkah to shopping centres is an important part of the daily movement of people and traffic in the city, representing a significant investment in time, fuel and money. Obviously, the ease with which shoppers can travel from origin to destination varies greatly in accordance with the character of the journey. The reasons for these variations will also be considered. Besides the journey to the shopping centres, a second problem is the demand for car parking space near the shops. This is generally inadequate and can lead to a serious problem for the city transport system as a whole.

8.2 Shopping Centre Location

One of the most distinctive characteristics of the city centre in a Middle Eastern city is the Suq, or market. "The bazaars in Cairo, Damascus, Jerusalem, Tunis and Casablanca are famed 'department stores', workshops and business areas." (1) In Makkah the size and extent of the commercial activities can largely be attributed to the religious function of the city. The city serves its permanent population (600,000) and a considerable number of visitors and pilgrims from all parts of the world (the total number of pilgrims in 1987 was about 2.1 million [2]). Additionally, the city serves as the centre for its non-urban hinterlands providing a variety of services, and goals to the rural and nomadic population. This activity alone is enough to keep the city streets busy, especially those near and around the shopping areas.

The Haram is the main focus for visitors throughout the year, with high peaks during the annual Hajj and the month of Ramadan. This has resulted in the creation of several central shopping zones, each of which specialises in certain commodities. The suqs selling meat, vegetables, fruit, bread and other daily requirements, initially clustered in three main areas which are close to Al-Haram, Suq Al-Lil, east of Al-Haram, Al-M'ala, north of Al-Haram and Suq Al-Saqeer, west of Al-Haram. Suq Al-Shamiah, north-west of Al-Haram, is another specialised suq, selling jewellery [3]. This suq was described by a Muslim historian as having similarities with the design of Turkish suqs. It has a fine wooden roof similar to Khan Al-Khalili in Egypt. In this suq, Indian and Turkish clothes are chiefly sold, besides other goods for permanent residents as well as visitors [4]. A similar suq is located north of Al-Haram and just a few hundred yards from it, with congested rows of old shops along its sides. This suq is the largest in Makkah. Mixed commodities are sold here, such as religious books, traditional perfumes (brought from India), beads and prayer rugs, as well as clothes. This suq becomes exceptionally busy during the main seasons of Ramadan and Hajj when overseas seek souvenirs. Another suq, east of Al-Haram, specialises in selling jewellery, called Suq Al-Dahab or the Gold Market. This suq is the only suq in the city to do so. Some jewellery shops recently opened on Al-Masjed Al-Haram street and on Al-Seteen street in Al-Rusifiah district and Al-Utibiah district. Al-Ghaza suq to the north of Al-Haram is another famous specialised suq where fashionable clothes are sold (5). In Ajiad district, and still only a few hundred yards south of Al-Haram, a mixed commodity centre is located opposite Ajiad Hospital. All these suqs serve the entire city of Makkah, so that the area around Al-Haram tends to be extremely busy at all times, but it becomes especially congested during the Hajj and Ramadan. These suqs remain the city's most important shopping areas; the few shops in residential areas clearly cannot satisfy demand. People shopping in the area mingle with the motor traffic, which inconveniences shoppers and hinders traffic flow. Moreover, there is no proper car parking suitable because of the shortage of open spaces and the narrow streets.

Since 1955, however, following the enlargement of Al-Haram, the landscape of the city centre has been undergoing rapid changes in shape and character. Many of the older business areas were demolished, including Al-Shamiah Suq, Suq Al-Saqeer, Suq Al-M'ala and part of Suq Al-Lil. 793 shops were demolished at the time of the Al-Haram enlargement (6). Most of the demolished shops were re-sited along the main streets leading to Al-Haram in order to benefit from being as close as possible to the city centre and Al-Haram. Some shops were relocated away from Al-Haram to serve people who migrated from the city centre because their houses were demolished; 583 houses were demolished at the time of the Al-Haram enlargement (7). The creation of these new shops in new districts, such as Al-Jumaizah. Al-Maabdah, Jarwal and Al-Utibiah was also encouraged by compensation paid to traders.

The general development of the country during the oil boom has also led to the development of shops in other parts of the city. Today almost every district has commercial retail activity in the form of shops and modern supermarkets. The districts which have the best developed commercial retail activities are Al-Aziziah, Al-Seteen, Al-Monsoor, Al-Taneem, Al-Hafayar, Al-Shubikah and Al-Missfalah. This increase of commercial activity also reflects the marked growth of the city's population in recent years. The spread of commercial activities in most parts of the city has resulted in the emergence of two types of commercial activity; firstly, the neighbourhood shops, and secondly the larger, specialised stores and supermarkets. Both may be privately owned and commonly open from 08.00 until late in the evening, with a period of closure during the day. This situation is similar to that in other Saudi cities, and is similar to hours of opening in Jordan, which are from 09.00 to 13.00 and from 15.00 to 19.00 (8).

Neighbourhood shops are usually found along most secondary streets in all residential areas. Some of the best examples of this type of neighbourhood shop are scattered along Abrahim Al-Khalil street, which serve people in Al-Missfalah district. They serve the daily needs of the population for fresh bread, vegetables, eggs, cheese and other fresh food. The second major type of shop is the specialised store, both wholesale and retail. This type of shop offers shoppers a far greater range of merchandise than do neighbourhood shops. Examples of this type are Al-Mashat Centre and Al-Tassan Centre, located in Al-Seteen street. These centres are composed of shops specialising in high-quality ladies fashion, childrens' clothes, and European goods such as shoes and perfumes. This type of specialised shop occupies either the ground floor of one building in the residential area or a purpose-built shopping centre in a residential area but not associated with dwellings. A good example of this type is Al-Aziziah central market in Al-Aziziah district. These shops serve the entire city, and even some of the non-urban settlements near to the city. These specialised shops are not numerous and are usually found at the city fringe, mainly in the newly-developed districts. The siting of these shops on the city fringe increases the distance differential between specialised shopping facilities and the focal points in the districts throughout the city. Here a question arises as to whether the location of these types of shops affect city shoppers' habits, and how difficult it is to travel long distances from home to the shopping areas (specialised shops). A further point to be mentioned here is that these specialised neighbourhood shops may result in traffic disturbing pedestrian movement with on-street parking. To what extent on-street parking is adequate for shopping at these centres has not been previously investigated.

To answer the questions mentioned above, we conducted an investigation in 1984, to try to establish some answers from published data. Unfortunately, there is no such data, so we designed a survey to provide data which might be useful for the city planner in future. Data was sought both on the journey to shops, and on parking problems at destination, and these are discussed below.

8.3 Shopping Survey Methods

Surveys we carried out in the city had two approaches: interviews with shoppers, and vehicle counts of cars parked on streets near selected shopping areas. The purpose and method of each survey deserves some discussion.

In April 1985, we conducted the technical survey of counting street-parked vehicles at selected shopping areas. The purpose of this survey was to count parked cars and to classify them according to type of vehicle to establish the dominant vehicles used to travel to shopping areas. In addition, we included the method of parking at shopping areas (whether it is proper parking, double parking, block parking or parking in no-parking zones) to find out how these methods of parking affected passing traffic. To conduct this survey, five shopping areas were chosen, four of them located in a newly-developed district and one located in an old district away from the city centre. The city centre shopping area was excluded from the survey because there are two multi-storey car parks there which are extensively used as well as on-street parking. A separate survey was designed to find out whether these multi-storey car parks are adequate for all purposes including shopping (see Chapter 7). Moreover, we tried to avoid counting vehicles parked on streets with mixed land-use purposes, where reasons for parking are mixed in the centre of the city.

At each selected shopping area, parked vehicles were counted from 09.00 to 20.00. The survey was conducted every day for one month in April 1985, to determine whether the demand for parking spaces varies between weekdays and weekends. Vehicles were recorded on a field sheet every half-hour, including detalis of the vehicle type, and the quality and method of parking in each of the five zones. Variations in parking space demand from morning until late evening were also noted.

A problem associated with this survey was the difficulty in distinguishing the vehicles of shoppers from those of residents and employees.

A second survey was conducted in May 1987, at the same shopping areas chosen for the first survey, to interview shoppers. Fifteen days were given to conduct interviews, starting from the 15th of Shabaan (mid-May) to the end of the month. Three days were given to each shopping area to conduct interviews. This survey was designed to meet both men and women, to establish the shopping habits of both sexes and problems associated with their shopping journeys from origin to destination. The detailed purposes were to find out:

1 Shopping visits - time and frequency.
2 The method of transportation.
3 Whether the location of shopping areas caused access problems.
4 Availablity of parking facilities.

The questionnaire is shown in Appendix F. We used two methods to distribute the survey samples: 1) interviews with male shoppers at shopping centres, and 2) interviews with female shoppers at home, (with the help of female university students). We had no opportunity to interview women at shopping areas, for religious reasons. Three days were given to each selected area to conduct the male interviews, mainly in the morning and evening from 09.00 up to 20.00. Samples were taken randomly with any shopper willing to answer the questionnaire by moving from one shop to another along the two sides of the street. Ten minutes were given for each interview.

For the interviews at home we asked women lecturers in Umm Al-Qura University to distribute samples randomly in every department in the lecture halls. Moreover, we asked lecturers to divide samples equally for each department and to give these samples to girls at random, by giving three samples to every three girls. Each girl getting the survey samples took them home to interview her mother, and then returned them to us. The same method was followed at the female students' college which is under different administration in the city of Makkah. Altogether 1,200 survey samples were distributed, divided equally between male and female. 860 samples were returned, 703 of which were found to be valid. Samples not returned were almost equally male and female.

The chief problem of this survey was lack of funds with which to pay field assistants as in 1985. Apart from occasional help from friendly teachers in the evening, the survey was conducted entirely by the author. Thus the time of the interviews expanded from three days to five days at each shopping area chosen. Finally, the high temperature in the morning made interviews with shoppers very uncomfortable.

8.3.1 Shopping Survey - Findings

During the 1987 survey, 63% of male shoppers responded to the questionnaire, and only 37% of the female shoppers responded. The reasons for the poor female response rate are not clear. The study also revealed interesting discrepancies in the proportion of shoppers by age (Table 8.1). Almost 78% were in the age group 21-40, representing the working group, with good incomes and high levels of family consumption. Shoppers aged between 18 and 20 years old formed 15.4% of shoppers. The over 40 group is low, largely because of the traditional habits whereby elderly parents have shopping done for them.

Table 8.1 Shoppers According to Age

Age Group	Number	%
18 to 20	108	15.4
21 to 40	547	77.8
More than 40	48	6.8
Total	703	100%

Source: Fieldwork in May 1987, Makkah, Saudi Arabia

8.3.2 Origins of Shoppers (by District)

The purpose of this section is to discuss the dominant districts for the generation of shopping trips. The study revealed that districts 4, 2, 8, 9, 1, 7, 3 and 16 produce the highest proportion of shopping journeys within the city (Table 8.2). This is not surprising because of their large populations. As already mentioned, the city provides services for certain non-urban settlements. We found from the survey that Fatma Valley, north of Makkah City (which contains several villages) produces 6.5% of shopping journeys, while Al-Sharaii Valley forms a lower percentage (0.3%). From these percentages it can be seen

Table 8.2 Origin of Shoppers by Districts

Code	District	Number	%
1	AL-Zaher	53	7.6
2	AL-Aziziah	80	11.4
3	Jarwal	33	4.7
4	AL-Missfalah	88	12.5
5	AL-Falq	6	0.9
6	Amir Path	18	2.7
7	AL-Mansoor	43	6.1
8	AL-Rusifah	71	10.1
9	AL-Utibiah	65	9.2
10	Fatma Valley	46	6.5
11	Jabal AL-Noor	3	0.4
12	AL-Khansa	4	2.0
13	Ummra	9	2.7
14	AL-Nuzha	27	3.8
15	AL-Shamiah	3	0.4
16	AL-Maåbdah	33	4.7
17	AL-Zahra	12	1.7
18	AL-Shisha	9	1.3
19	AL-Taneem	3	0.4
20	AL-Hafayer	17	2.4
21	AL-Kakiah	10	1.4
22	Hajj Street	14	2.0
23	Ajiad	18	2.6
24	AL-Sullimaniah	4	0.6
25	Harat AL-Bab	2	0.3
26	AL-Awali	5	0.7
27	AL-Adel	3	0.4
28	Mina	1	0.1
29	AL-Shubikah	1	0.1
30	AL-Sharaii	2	0.3
	Total	703	100.0%

Source:Fieldwork,May 1987,Makkah.

that shopping journeys from villages around the city must add to the traffic volume on the city network and raise demand for car-parking spaces. It is also noticeable from Table 8.2 that some districts produce a low frequency of shopping journeys. These districts are 19, 21, 26, 28, all of which are relatively recently developed and their populations remain small. Certain other districts appear to produce a small proportion of shopping journeys, but these are not explained by low population. It may reveal the small number of shoppers we interviewed from these districts. The random samples taken among female students may have affected the results because of bias in the districts with a huge population of students. As would be easily shown by the application of a simple gravity-flow model, population size is a key factor in creating shopping demand. A further key demand is income, which it was not possible to follow up because of difficulties in obtaining data.

8.3.3 Shopping Habits

The purpose of this section is to establish the habits of shoppers going out for shopping journeys. Such habits we hope to find are how frequently city people go to shops during the week, and preferred times to do their shopping. To understand shoppers' movements is basic to understanding city traffic and demand on facilities such as parking. The survey results showed that the majority (86.2%) of shoppers prefer to do their shopping in the evening. Since most are in employment or are students, evening is the obvious time. By contrast, shopping in Britain is often done from the place of work (particularly during lunch breaks or after work has finished) [9]. But this does agree partly with practice in Makkah, where shopping activity after working hours is quite common, if only to buy small purchases for their daily needs such as bread or fruit which does not require much time to stop at shops open to provide such services. Most shops in the city are closed between 13.00 and 15.00, when people prefer to be at home to eat lunch and to avoid the high temperatures outside. These factors keep shoppers' numbers small in the morning (13.8%). There is a distinctive variation in patterns of shopping activity during the week. The days preferred by shoppers are at weekends (Thursday and Friday) with 47.2% (Table 8.3) when holiday provides an opportunity for shopping. People who shop only at weekends usually shop for the whole week [10]. Some shoppers (12.2%) shop twice a week, while those who go shopping every day and from four to six times during the week together form 11.4%.

This may reflect that some people hang on to their inheritied tradition of going to market every day. From the survey results it was found that 50.2% of shoppers go to only one market on the day of shopping. Table 8.4 illustrates some reasons given for shopping at one market only. It is worth noting that 22.4% wished to avoid heavy traffic by shopping at one centre only.

Table 8.5 illustrates the reasons for going to more than one market in a day. The most significant factor causing shoppers to move to more than one market is prices of goods (52.9%).

Table 8.3 Frequency of Visits to Shops

Frequency	Number	%
Every day	55	7.8
Four to six times	25	3.6
Three times a week	49	7.0
Twice a week	86	12.2
Once a week	156	22.2
Only at weekends	332	47.2
Total	703	100%

Source: Fieldwork, May 1987, Makkah, Saudi Arabia

Table 8.4 Reasons for Preferring One Shopping Centre

Reasons	Number	%
Proximity to home	86	24.4
Variety of goods	144	40.8
All of the above	123	34.8
Total	353	100%

Source: Fieldwork, May 1987, Makkah, Saudi Arabia

Table 8.5 Reasons for Preferring More Than One Shopping Centre

Reasons	Number	%
Goods unobtainable in one market	157	44.9
Price differences	185	52.9
No traffic difficulty	8	2.2
Total	350	100%

Source: Fieldwork, May 1987, Makkah, Saudi Arabia

8.3.4 Methods of Transportation

This section discusses the means of transportation used on shopping trips. The survey results (Table 8.6) showed that a total of 83.8% of shoppers use their private cars to go shopping. This reflects the high percentage of car ownership and use among the city population (see Chapter 3), which clearly raises the traffic volume on city streets. On the other hand, the use of taxis (7.1%) and public buses (2.6%) is very low.

We asked both private car users and bus passengers to give us reasons for choice of transport; this will be discussed in the section 8.3.4.1. In addition, 6.2% of shoppers accomplish the journey on foot. The use of motor cycles is notably low in Makkah compared with European or Japanese cities.

Table 8.6 Method of Transportation to Shopping Areas

Method of Transport	Number	%
Private car	448	63.7
Private car with driver	80	11.4
Private car with husband	43	6.1
Private car with son	18	2.6
Taxi	50	7.1
Bus	18	2.6
On foot	44	6.2
Motor cycle	2	0.3
Total	703	100%

Source: Fieldwork, May 1987, Makkah, Saudi Arabia

8.3.5 Choice of Method of Transport

The purpose of this section is to compare the use of two types of transportation, the private car and the public bus. The goal of this comparison is to establish the dominant factors influencing choice of transport, which might assist city planners when deciding whether planning should emphasise one or the other method in future. The survey results showed a marked preference for the private car over the public bus.

Table 8.7 Reasons for Use of Private Car

Reason given by Shoppers	Number	%
Difficulty geting taxi	18	2.6
Convenience	97	14.0
Riding with maharam	61	8.8
Move easily from one market to another	46	6.6
Long distance	10	1.4
More economical	260	37.5
Loads goods conveniently	113	16.3
Save time	67	9.7
Cannot walk	5	0.8
Inadequate buses	16	2.3
Total	693	100%

Source: Fieldwork, May 1987, Makkah, Saudi Arabia

One of the most significant factors is that the private car is more economical according to 37.5% of the interviews (Table 8.7). The money paid to travel by bus from origin to shopping destination and back is enough to buy four gallons of cheap petrol, enough to run a private car a great distance in the city. 16.3% of shoppers preferred private cars too for the convenience of loading goods, especially when buying vegetables, fruits and other needs in bulk from the Halqa (wholesale vegetable market), sometimes for very large households of up to a dozen persons. Private cars can also provide door to door service which 14% of shoppers mentioned. In addition, some 9.7% of shoppers claimed to use their private cars just to save time. This becomes a special advantage when shoppers travel from one market to another, which nearly 7% commonly report doing. The public bus is confined to fixed routes and schedules; thus 2.3% of shoppers stated that they use their private cars because the public bus does not meet their travel demands. One of the significant results obtained from the survey showed that 8.8% of female shoppers preferred riding in private cars with their maharam, that is, father, son or brother, rather than riding with a strange driver such as a bus driver, taxi driver or chauffeur. Such social factors are important in transport planning in Makkah.

A few shoppers, on the other hand, stated a preference for bus travel. A small number of shoppers (19.1%) use the bus because it does not require parking spaces (Table 8.8), some do not own a car, while eleven bus users (52.4%) use the bus because it is economical.

Table 8.8 Reasons for Use of the Public Bus

Reasons	Number	%
Not requiring parking space	4	19.1
Have no car	6	28.6
Economical	11	52.4
Total	21	100%

Source: Fieldwork, May 1987, Makkah, Saudi Arabia

8.4 Access to Shopping Areas

Measuring accessibility has two aspects. One is the accessibility of places, such as how easily certain places can be reached. The other is the question of how easily people can reach activity sites (11). In this section we will discuss the case of access of shoppers to activity sites, which is a vital aspect of planning as mentioned by S. Hanson (p.5):

> Many scholars have argued that the ease with which people can reach employment locations, retail and service outlets, and recreational opportunities should be considered in any assessment of the health of the city (12).

The survey results showed (Table 8.9) that 1.7% of shoppers found very easy access to the shopping area, while 43.4% of shoppers found easy access to shopping areas. These two groups are probably those who go to only one market area for reasons mentioned in Table 8.4, thus saving time and distance. On the other hand, the survey results showed that 49.8% of shoppers found it very difficult. These difficulties will be discussed below.

Table 8.10 illustrates difficulties facing shoppers going to shopping areas. It is noticeable from the Table that the most significant problem making access to shopping areas difficult for 43.7% of shoppers, is traffic congestion en route to shopping areas. This occurs because of the variety of traffic moving for different purposes, and because of the use of the kerbside for the parking of private cars, trucks delivering or receiving goods, and taxis where this refers to the absence of the suitable terminals (parking). Another significant problem making access to shopping areas difficult for 2.3% of shoppers, is the long distance. A further significant problem making access to shopping areas difficult for 2.1% of shoppers, is said to be the existence of many traffic lights en route. Hollows and narrow roads with 0.7% and 0.9% respectively also create access difficulties for shoppers. These difficulties are similar to those discussed in Chapter 7, concerning access to hospitals. 2.3% of pedestrian shoppers complained about hazards they face from oncoming traffic en route, especially in crossing busy roads. Zebra crossings are not reliable and accidents to pedestrians can occur. The high temperature (0.1%) and the lack of shade (0.1%) also create access difficulties for shoppers.

Table 8.9 Access to Shopping Areas

Degree of Access	Number	%
Very Easy	12	1.7
Easy	305	43.4
Difficult	350	49.8
Very Difficult	36	5.1
Total	703	100.0%

Source:Fieldwork,Makkah,1987

Table 8.10 Problems Facing Shoppers en route to Shopping Areas

Type of Problems	Number	%
Heavy Trffic	307	43.7
Long Distance	16	2.3
Many Traffic lights	15	2.1
Hollows on Roads	5	0.7
Narrow Roads	6	0.9
Car causing hazards to pedestrians	16	2.3
High Temperature	8	1.1
No Shade on Streets	1	0.1
Cars Parked in correctely	9	1.3
Noise	3	0.4
No problems reported	317	45.1
Total	703	100.0%

Source:Fieldwork,Makkah,1987

Finally, cars parked incorrectly cause access difficulties to 1.3% of shoppers. The shortage of open spaces and the limited number of on-street parking spaces encourage drivers to park their cars by using unorthodox methods discussed in the coming section.

8.5 Car Parking Demand

One of the city's main problems is the great shortage of open spaces and parking places. The shopping areas in the city suffer from shortage of parking places. Comparing the situations in Makkah and Jeddah, it is found that there is a great shortage of parking places in Jeddah, where its central area in particular suffers more than any other area in the city because of great demand for parking places, both from shoppers and the workers employed in the C.B.D. (13).

Generally, the increase of car ownership in Makkah led to the intensive use of vehicles and high traffic volume on the city streets (see Chapter 5). As shopping areas form a temporary destination, there must be long- or short-stay car parking facilities. The increase in vehicle ownership in the city resulted in a high demand for on-street parking places. The increase in parking demand in the city is posing a major problem, affecting traffic flow and the environment. To evaluate the scale of the parking problem in shopping areas, we asked shoppers in the survey conducted in May 1987 about parking difficulties. The study revealed that 80.4% of shoppers who use their private cars faced major car parking problems in shopping areas. From this, it is clear that the demand on car parking spaces in shopping areas is significantly high. Parked vehicles were surveyed in shopping areas in Makkah during fieldwork in April 1985 to establish the variation in demand for parking places from hour to hour and from day to day. The method of parking used, and its effect on traffic flow, were also surveyed in 1985. Before discussing the findings, we should clarify the method of analysis. The analysis was based on taking the monthly average reading from the field record of the hourly variation, daily variation and method of parking. The data represents five shopping zones which are:

1 Ibn Khaldoon street (now Umm Al-Qura street) shopping zone;
2 Al-Mansoor street shopping zone;
3 Al-Seteen street shopping zone;
4 Abrahim Al-Khalil street shopping zone; and
5 Al-Aziziah street shopping zones.

Zone 1 is located about 5km west of Al-Haram, Zone 2 is located approximately 5km south-west of Al-Haram, Zone 3 is located about 8km west of Al-Haram, Zone 4 is located about 1.5km south of Al-Haram, and Zone 5 is located about 9km east of Al-Haram. These five sample areas give sufficient data on which to base some general conclusions.

8.5.1 Hourly Car Parking Variations

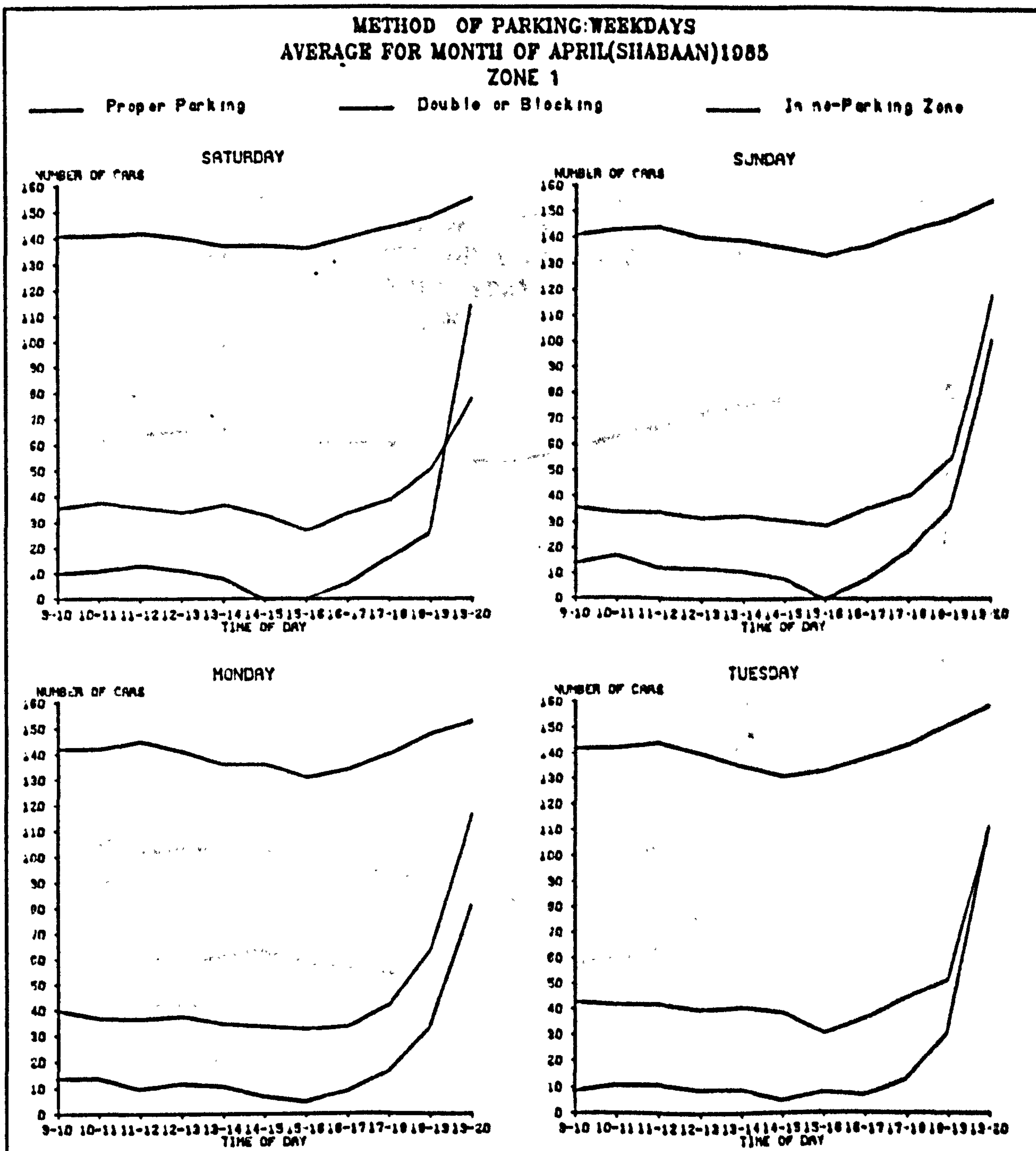
Figures 8.1 to 8.15 illustrate the hourly car parking demand variation. Two distinct peaks can be seen in each figure. The first peak starts at 09.00 and gradually builds up to reach its zenith between 12.00 and 13.00. After that time, the demand starts falling between 13.00 and 16.00. The second peak starts after 16.00 and gradually rises to reach its zenith at 20.00, which represents the end of our counting parked vehicles at shopping areas. Comparing the two peaks, it is found that the evening peak is the largest, which coincides with the result obtained from a survey done in 1987, which showed that the evening time is the most convenient time for shoppers.

It was surprising that demand for parking spaces near shops did not fall to zero between 13.00 and 16.00. The explanation for this phenomenon will be mentioned in the next section.

8.5.2 Daily Car Parking Variations

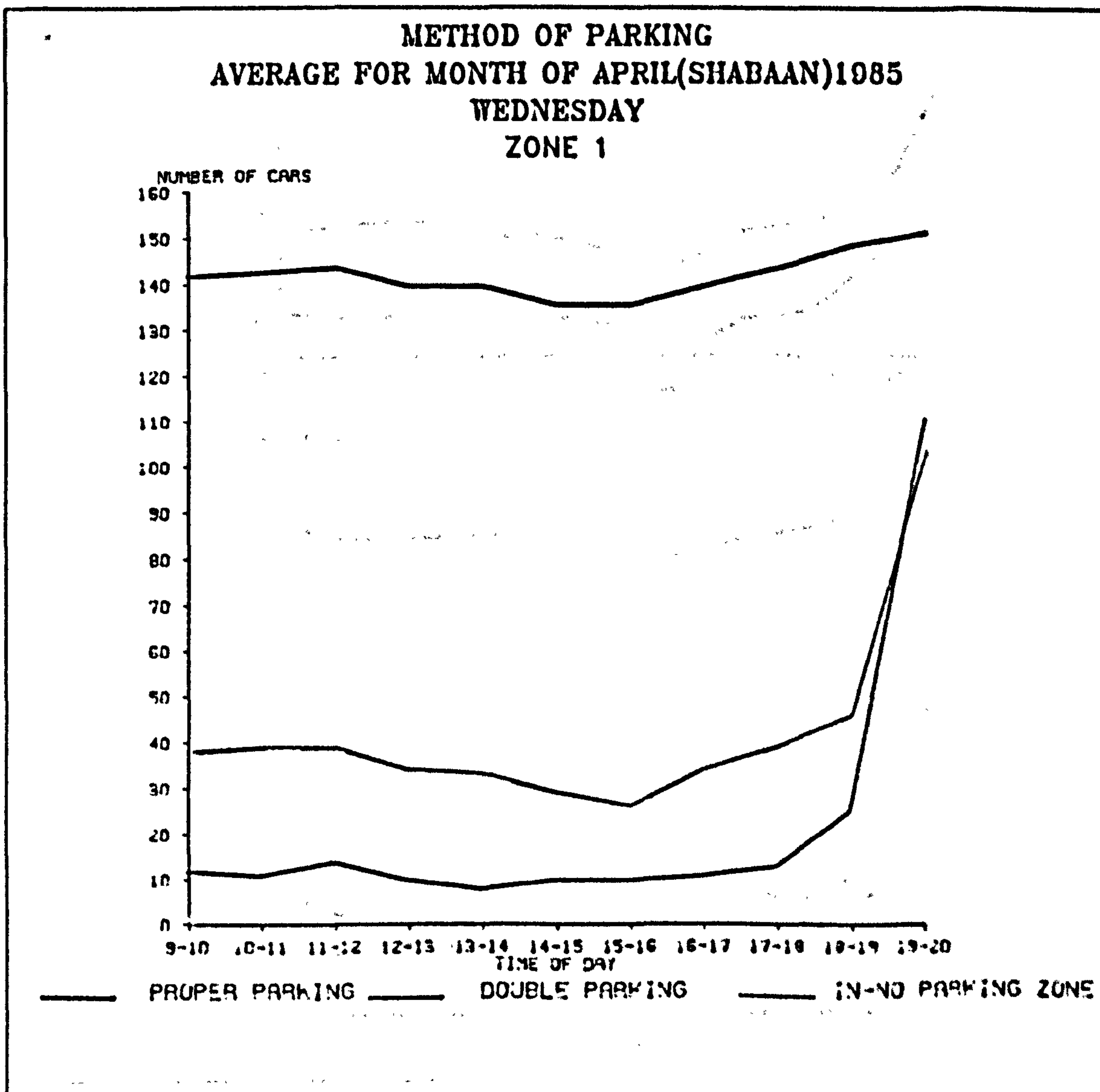
The study reveals that there are no big differences in parking demand at shopping areas throughout the week. The number of vehicles parked at weekends is nearly the same as on weekdays. This result does not entirely agree with the survey held in 1987, which showed that weekend shopping journeys are the highest. The explanation for this anomaly is the fact that mixed land use in the shopping areas created demand for parking spaces from other parkers in the area. Similarly, when shops closed between 13.00 and 16.00, there was demand for parking spaces. We could not

Fig.8.1



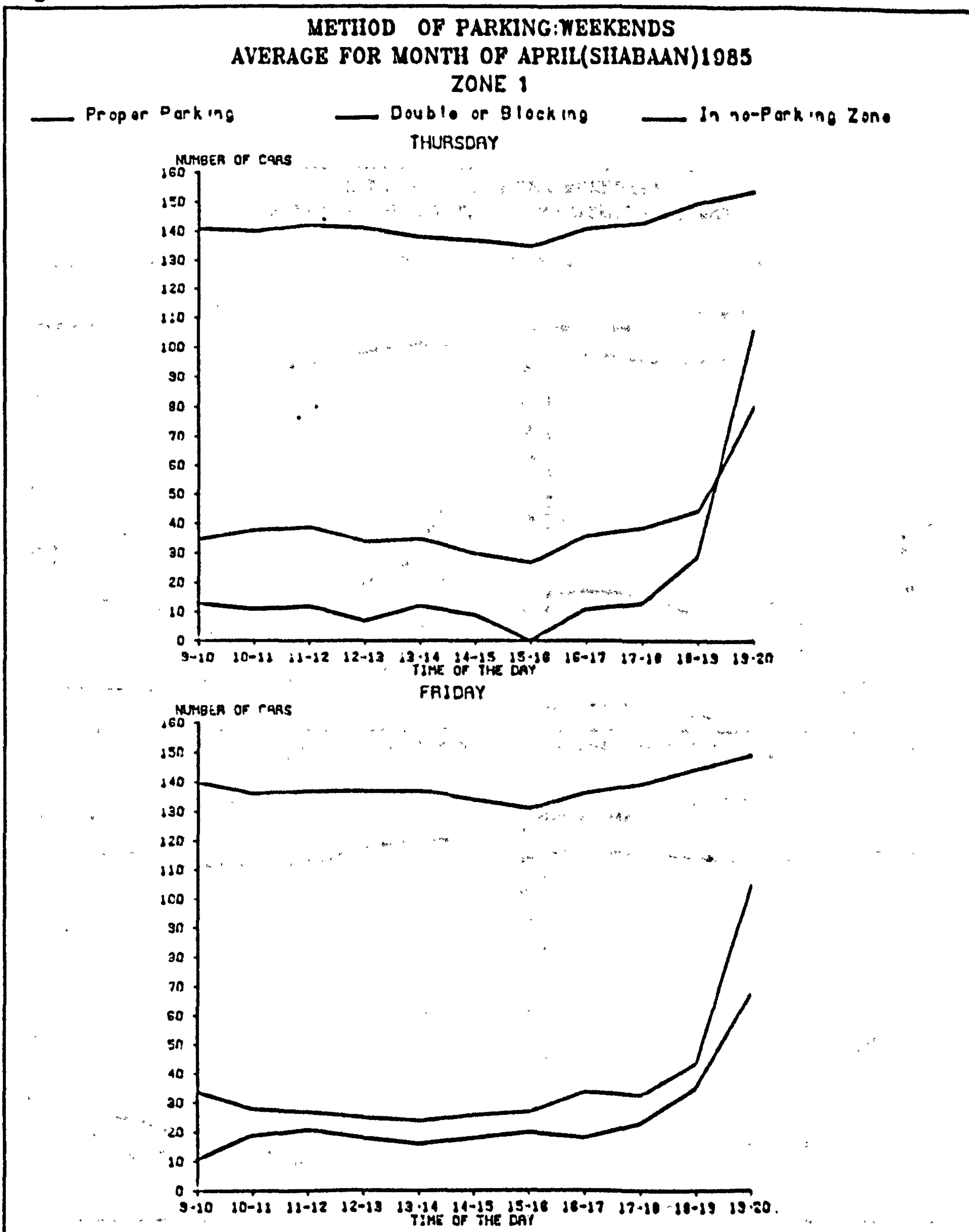
Source:Field Work,Makkah,(1985).

Fig.8.2



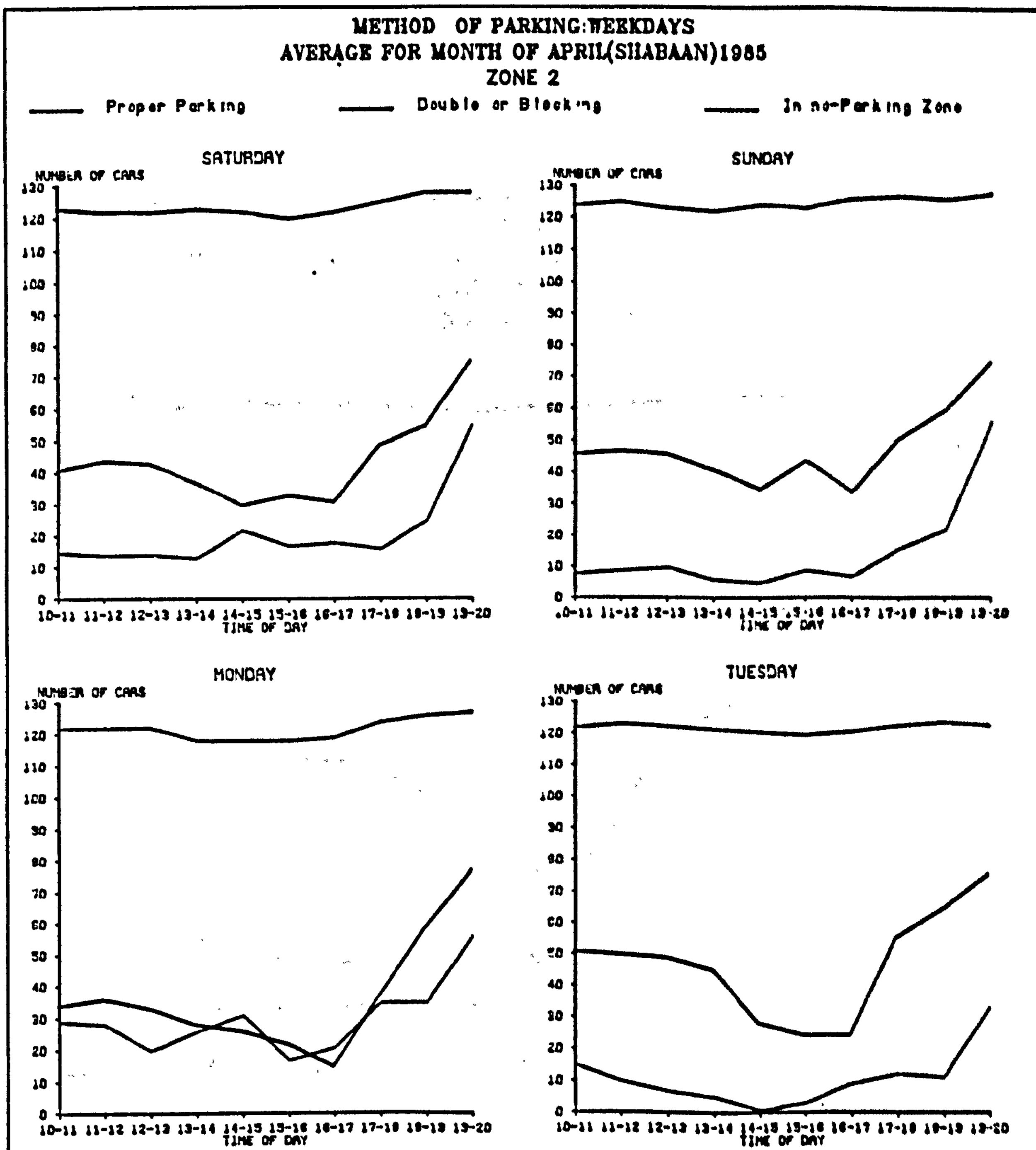
Source:Field Work,Makkah,(1985).

Fig.8.3



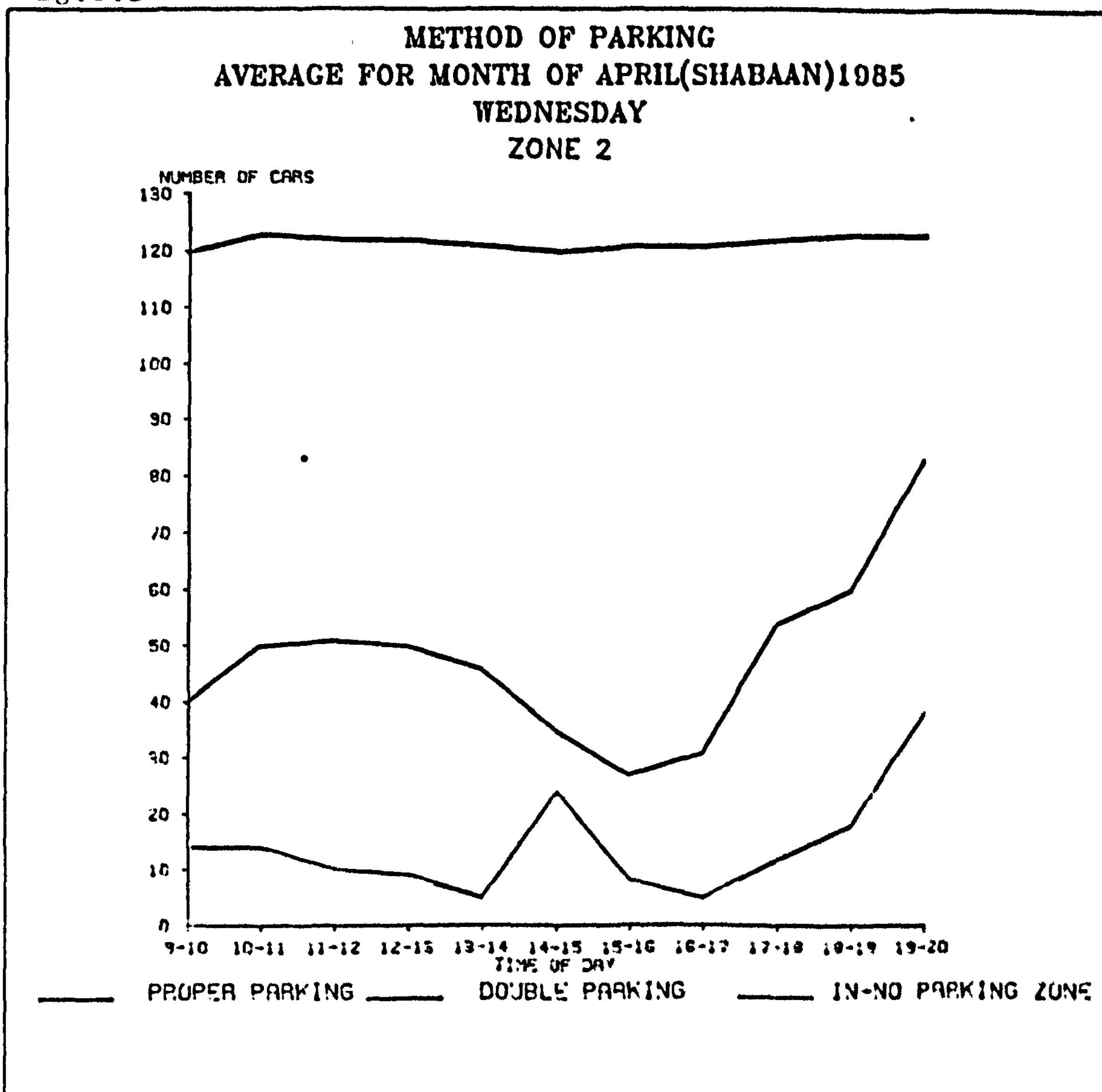
Source:Field Work,Makkah,(1985).

Fig.8.Ā



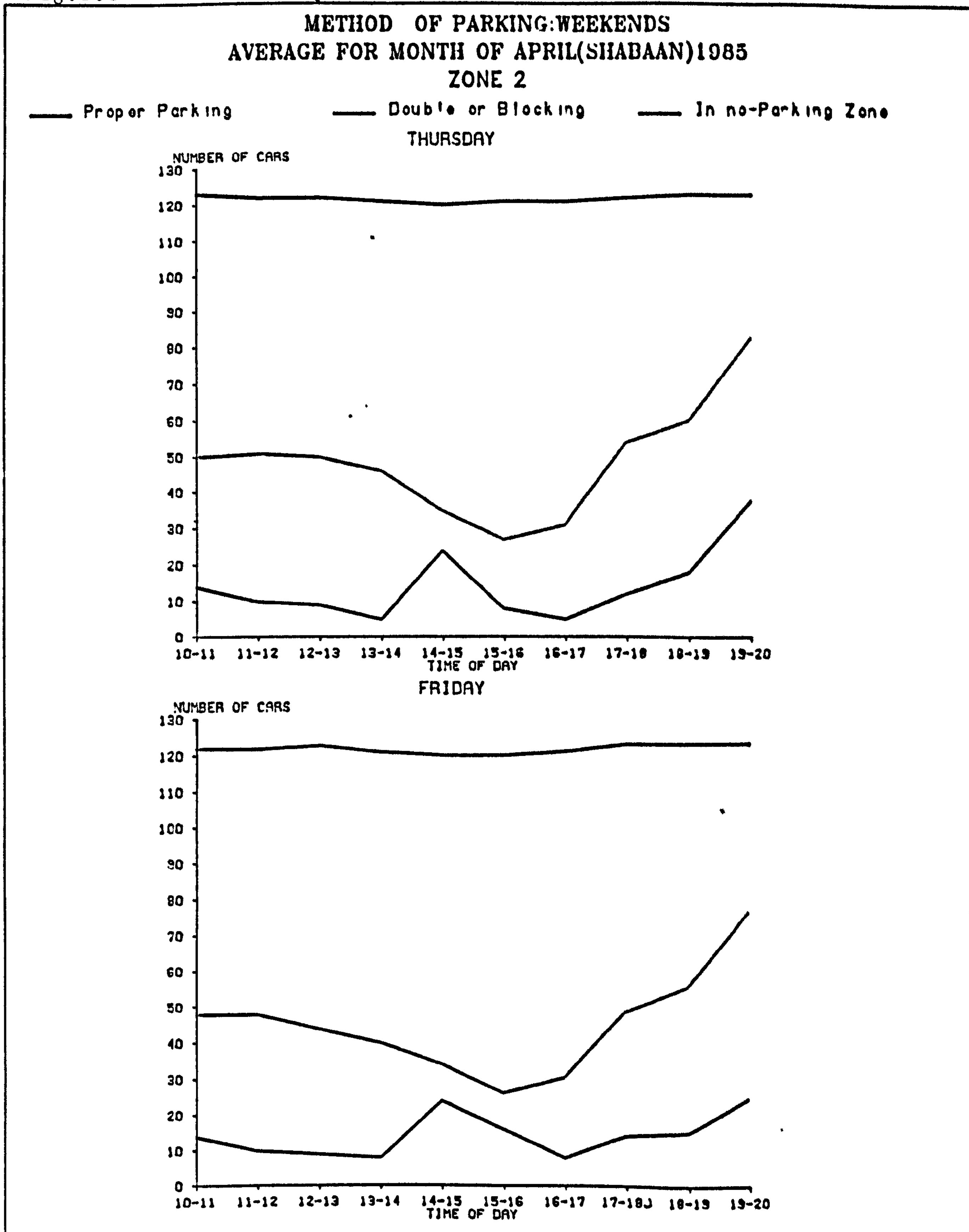
Source:Field Work,Makkah,(1985).

Fig.8.5



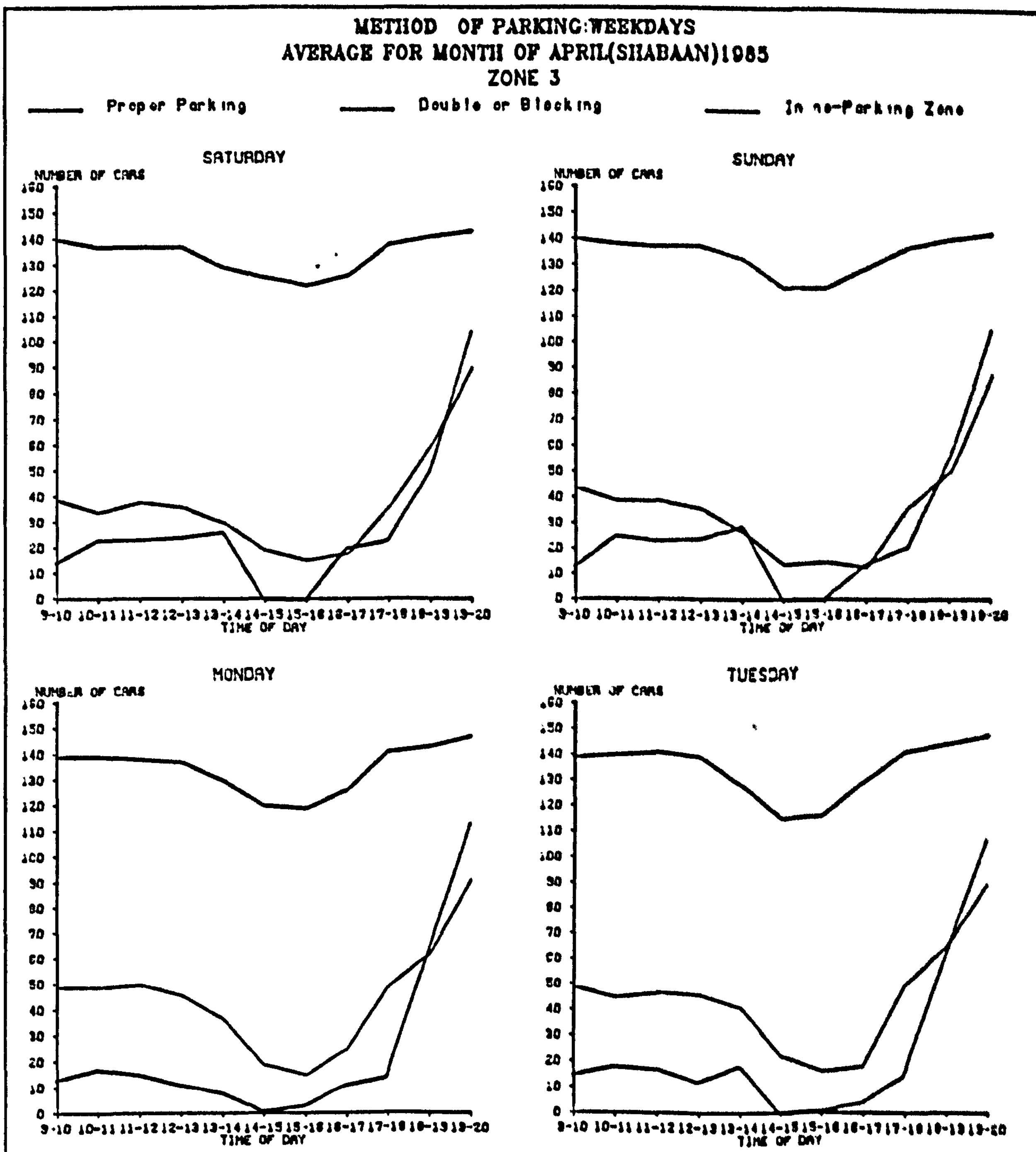
Source:FIELD Work,Makkah,(1985).

Fig.8.6



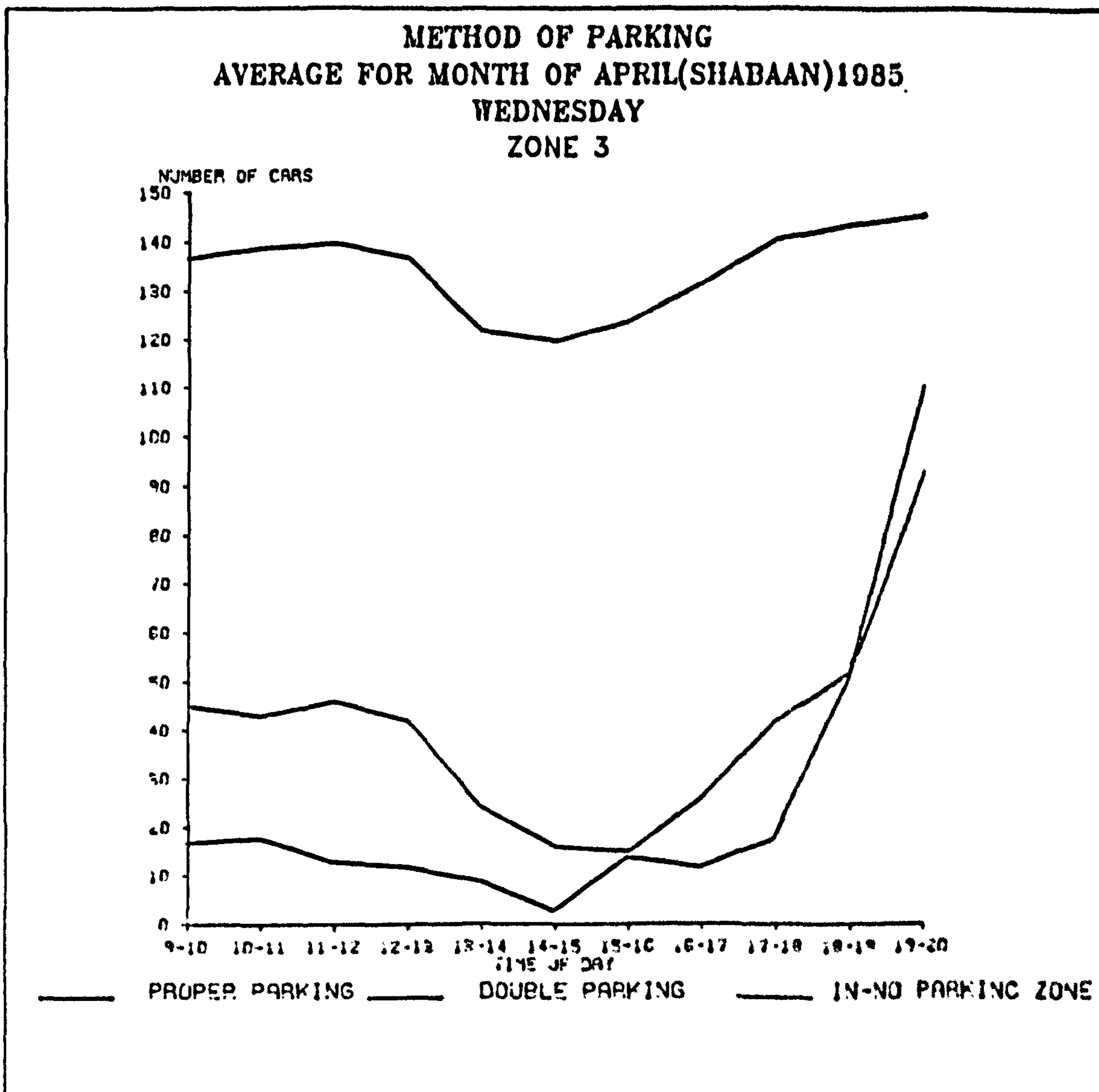
Source: Field Work, Makkah, (1985).

Fig.8.7



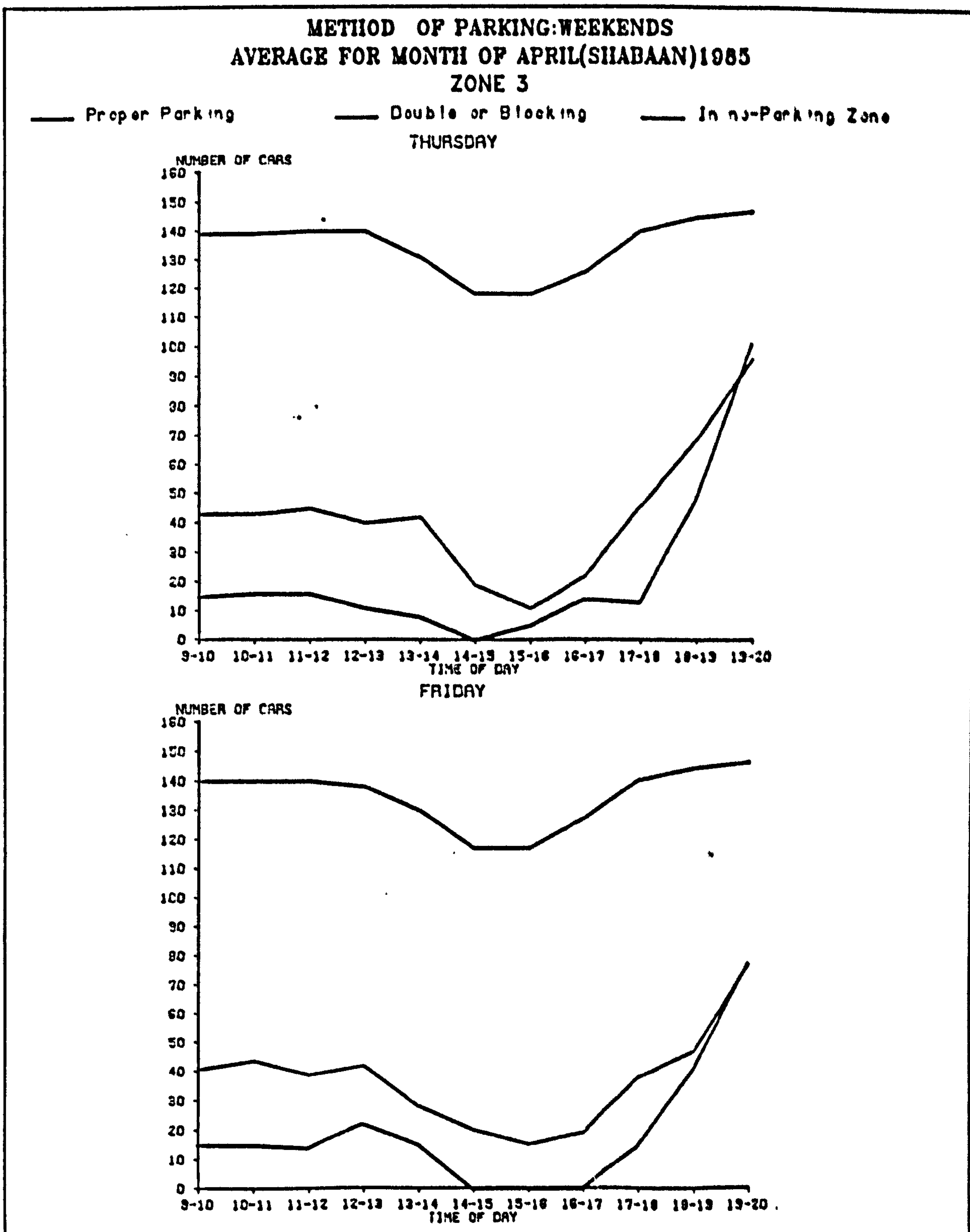
Source:Field Work,Makkah,(1985).

Fig.8.8



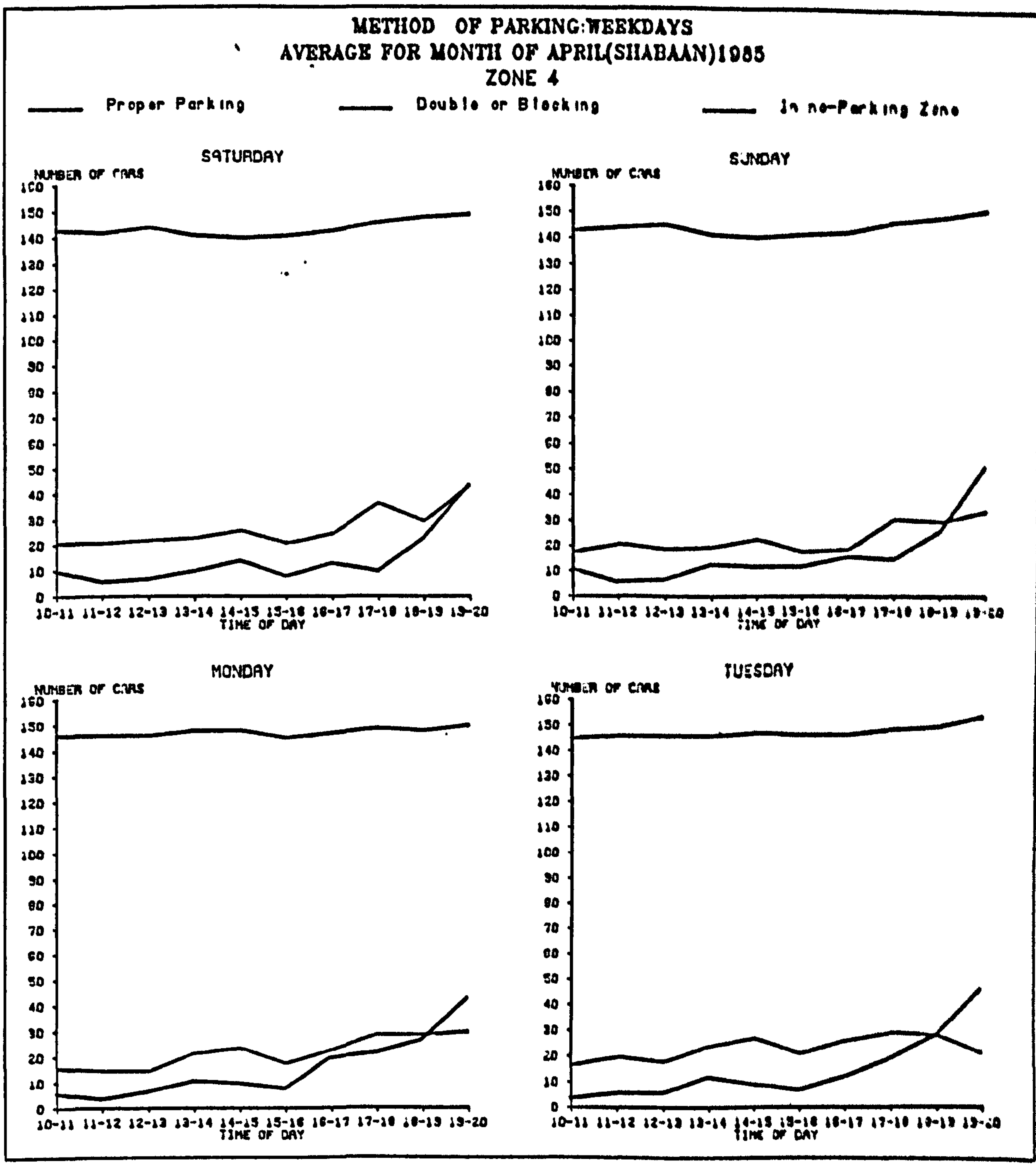
Source:Field Work,Makkah, (1985).

Fig.8.9



Source:Field Work,Makkah,(1985).

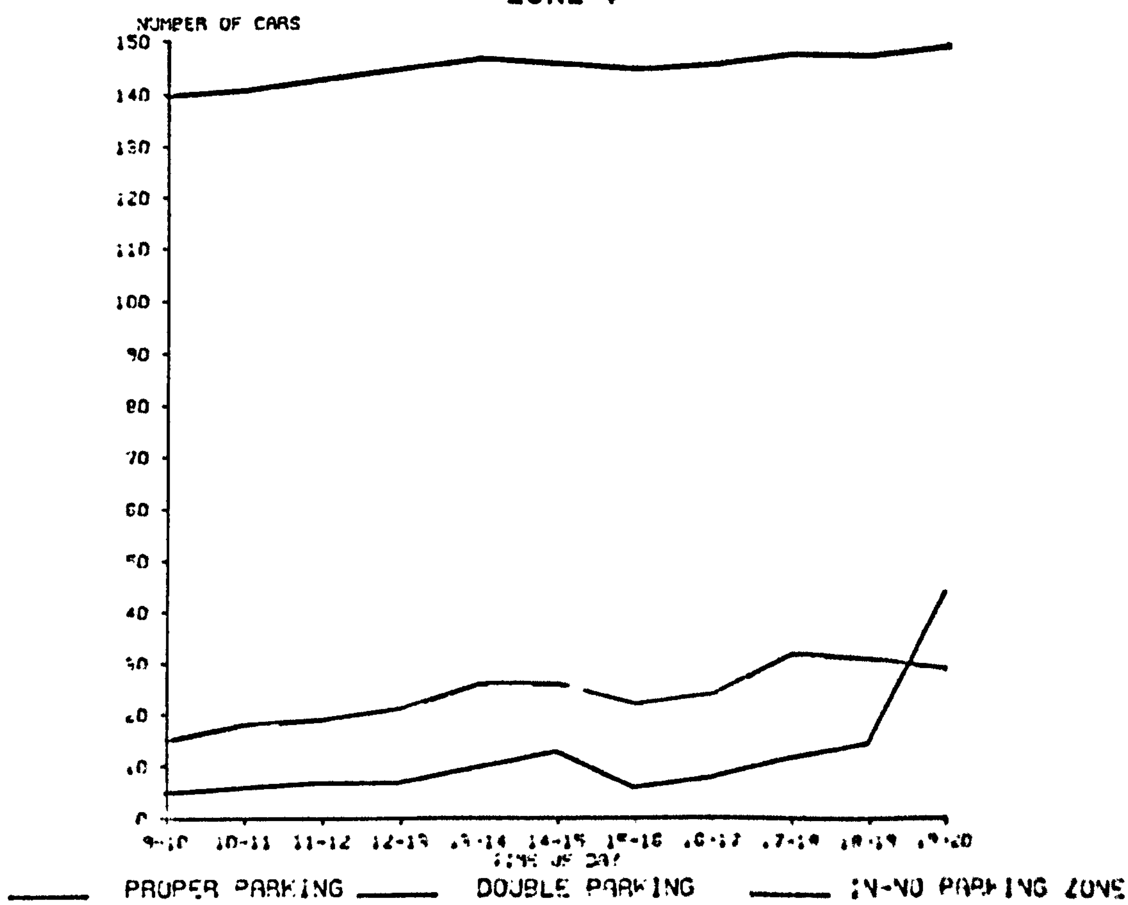
Fig.8.10



Source:Field Work,Makkah,(1985).

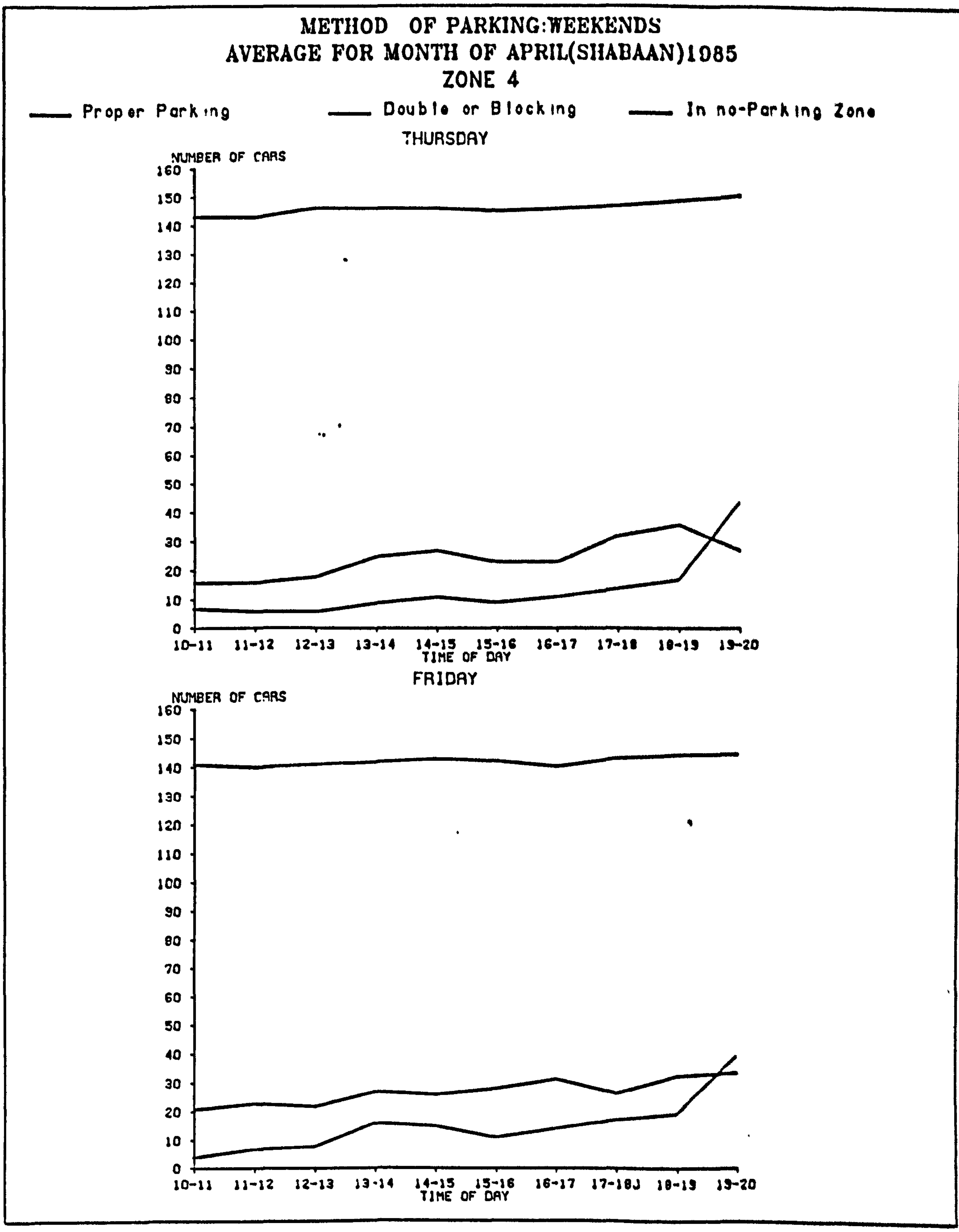
Fig.8.11

METHOD OF PARKING
AVERAGE FOR MONTH OF APRIL(SHABAAN)1985
WEDNESDAY
ZONE 4



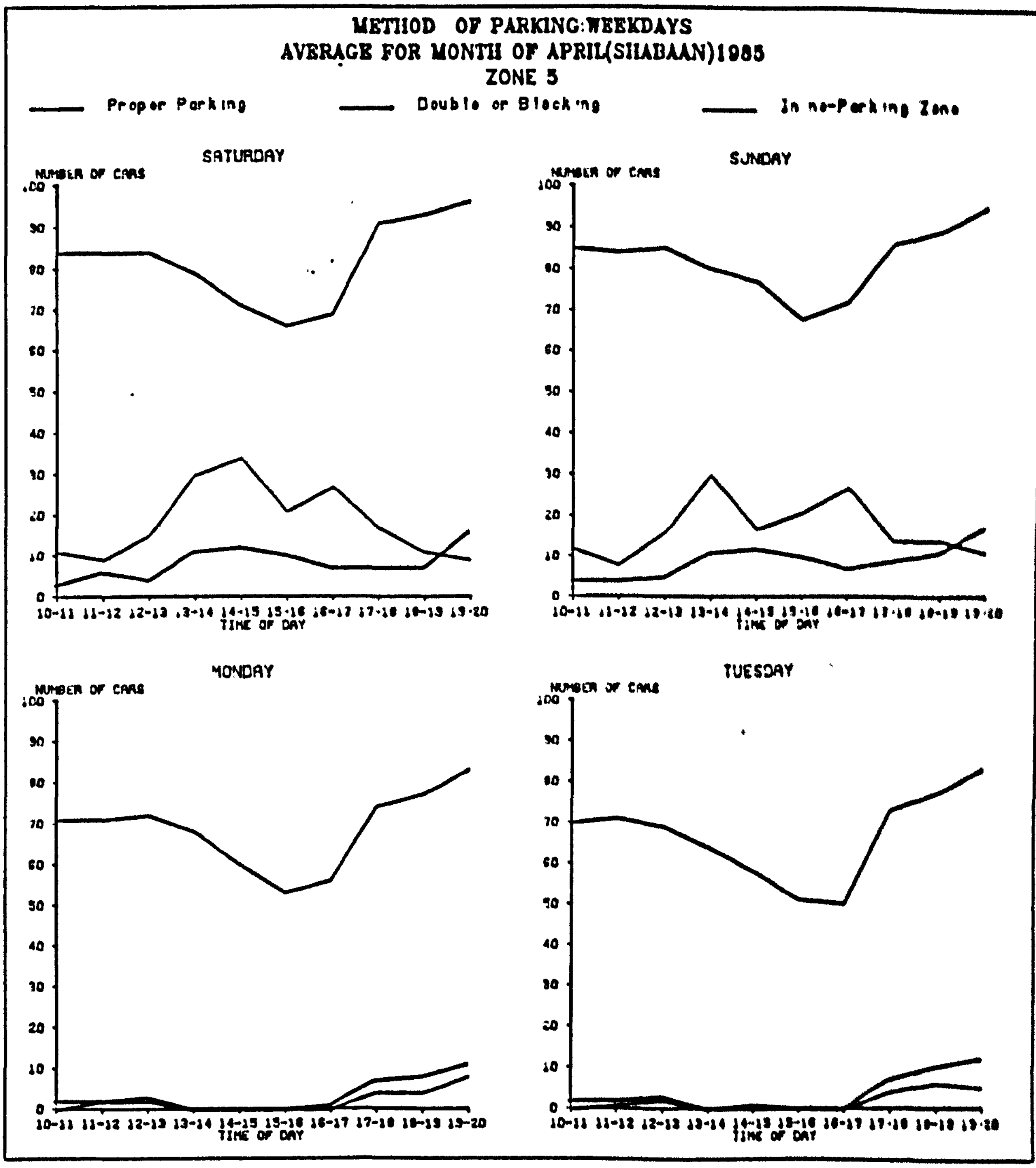
Source:Field Work,Makkah,(1985).

Fig.8.12



Source:Field Work,Makkah,(1985).

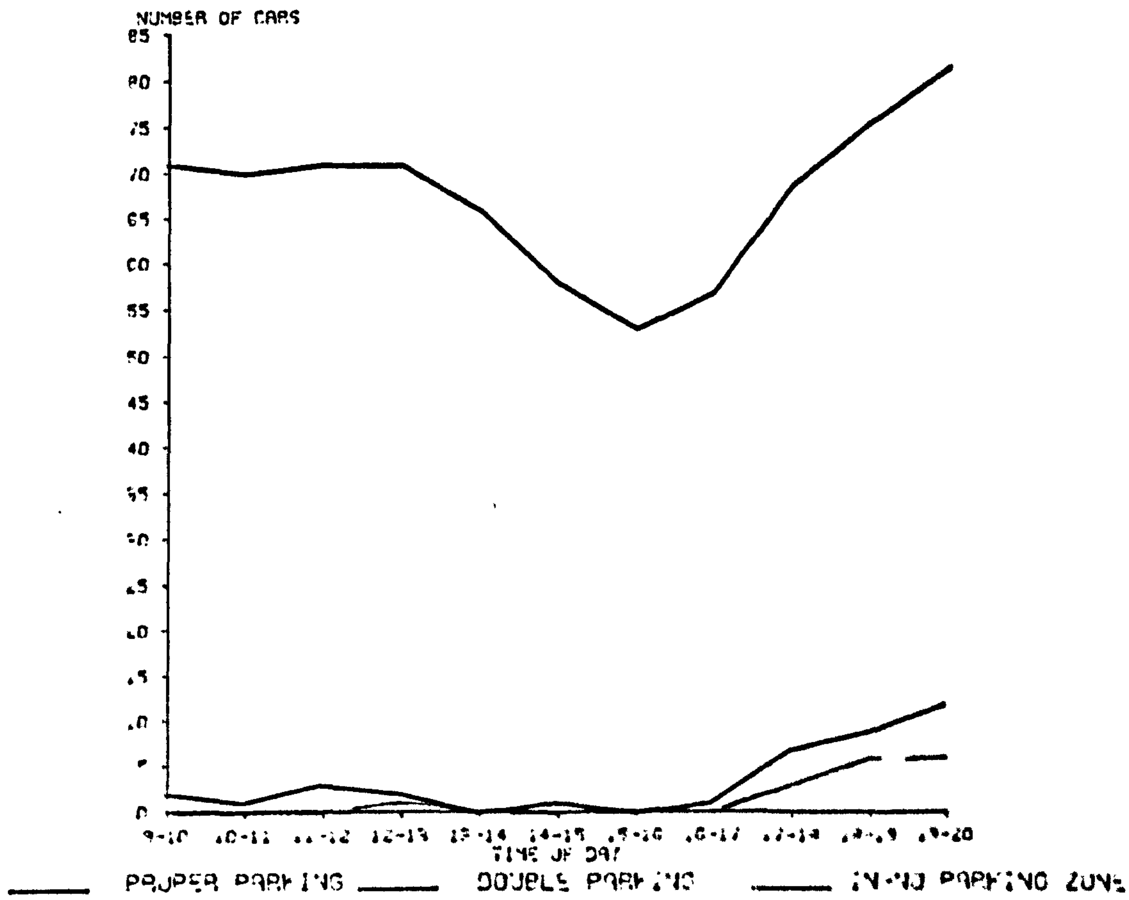
Fig.8.13



Source:Field Work,Makkah,(1985).

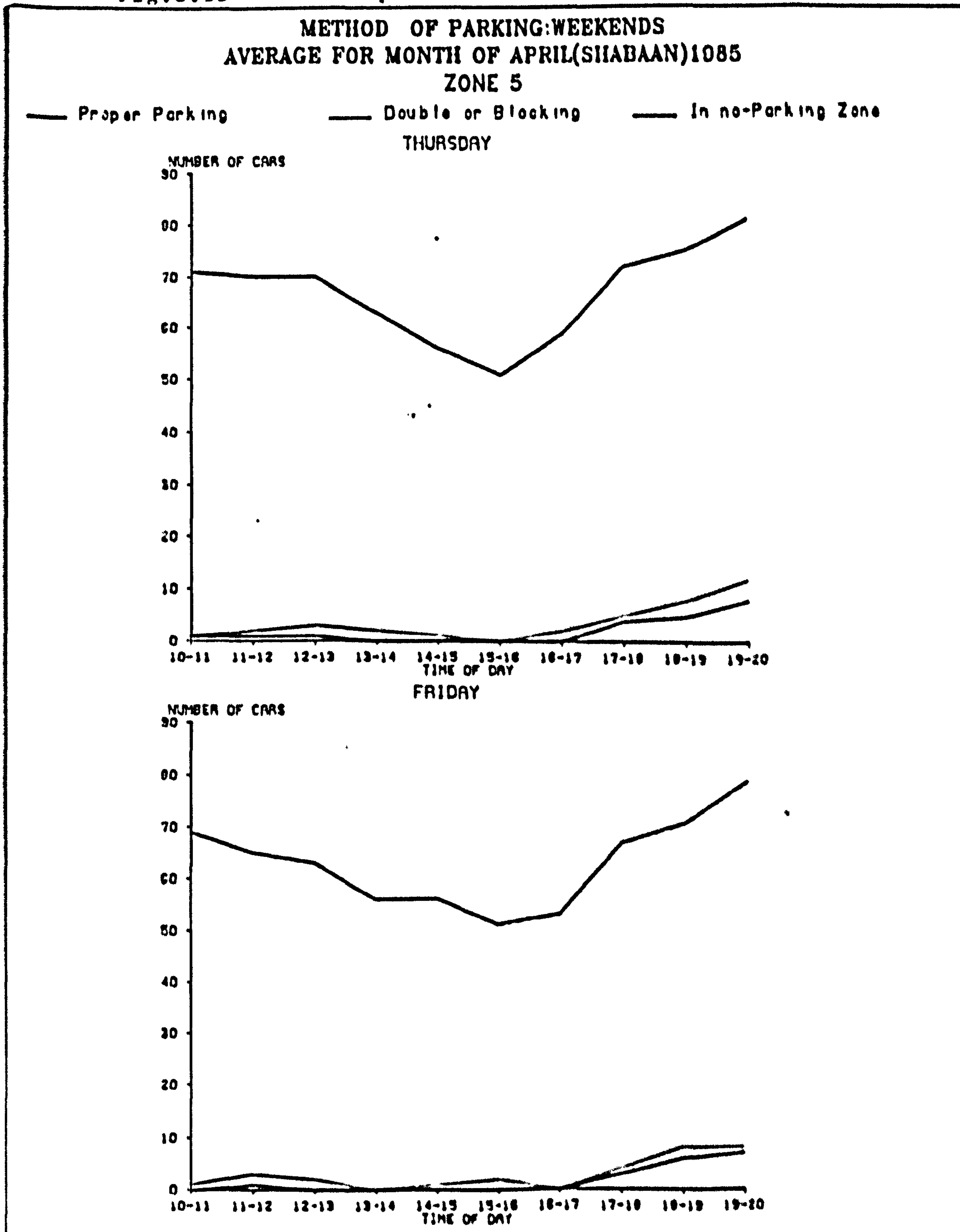
Fig.8.14

METHOD OF PARKING
AVERAGE FOR MONTH OF APRIL(SHABAAN)1985
WEDNESDAY
ZONE 5



Source:Field Work,Makkah,(1985).

Fig.8.15



Source:Field Work,Makkah,(1985).

distinguish between shoppers' cars and those who parked near houses, offices and schools located in the same area.

8.5.3 Duration of Parking

The purpose of this section is to establish the usual length of time spent by shoppers in the shopping areas, with special reference to car parking times. Table 8.11 illustrates the duration spent by shoppers in general at shopping areas in connection with the method of transport used. Those motorists who spent less than half an hour at shopping areas form only 15% of the total. Those who spent half to one hour form 14.7%, while those who spent one to one and a half hours form 17.4%, which is a large proportion. Moreover, those who spent from an hour and a half to less than two hours, together with those who spent two to less than two and a half hours, form 23.2%, which is the largest proportion, while those who spent more than two and a half hours form 13.5% of the total, which we also think high according to length of time at shopping area. There is thus a high and significant demand on parking spaces from between less than one hour to two and a half hours. This partly explains why many spaces on streets at shopping areas are occupied for long periods of time, encouraging unorthodox on-street parking which is discussed below.

Table 8.11, Duration of stay at shopping areas by shoppers and method of transportation

Method of Transportation / Length of stay	Private Car	Private Car with driver	Private Car with husband	Private Car with son	Taxi	Bus	Motor Cycle	On Foot	Total	%
From 15 to less than 30 minutes	97	6	3	-	1	3	1	10	121	17.2
From 30 to less than 60 minutes	89	8	5	1	5	3	-	7	119	16.9
From 60 to less than 90 minutes	106	8	5	3	15	4	1	5	147	20.9
From 90 to less than 120 minutes	55	13	6	1	8	3	-	4	93	12.[illegible]
From 120 to less than 150 minutes	55	20	13	-	12	3	-	8	111	15.[illegible]
More than 150 minutes	53	25	11	6	9	2	-	10	116	16.5
Total	455	80	43	11	50	18	2	44	703	100%
Percentage	64.7	11.4	6.1	1.6	7.1	2.6	0.3	6.2	100%	100%

Source: Fieldwork, May 1987, [illegible], Saudi Arabia

8.5.4 Parking Methods and Their Effects on Traffic Flow

Although there is no system of parking and no lines to define parking spaces, most parkers at shopping areas - as observed in the field and from the result of the survey in 1985 (see figures 8.1-8.15) - park at the kerb-side if spaces are unavailable. The shortage of parking spaces on streets at shopping areas, because of their location in residential areas, creates high competition for kerb spaces between shoppers and residents within the same area. This competition is becoming acute because all drivers try to park at the kerbside within acceptable walking distance. In the absence of kerbside space, drivers resort to double- or block-parking in no-parking zones. These two methods, as shown in figures 8.1-8.15, invariably occur in the two peak times for shopping, while they decline in the off-peak periods. The evening peak period tends to be the worst time for poor parking, although these two methods of parking are found to vary somewhat from one zone to another (see figures 8.1-8.15). The use of on-street parking causes congestion, frustration and delay, as well as causing accidents to vehicles and creating hazards for pedestrians. Street capacity is clearly reduced when parking occurs on both sides, sometimes to only 40% of its capacity. The overall cost of such parking problems to Makkah is very great indeed.

8.6 Conclusion and Recommendations

It is apparent from this study that city expansion led to greater distances between activity centres such as shopping areas. The location of certain specialised shops on the city fringe and in the residential areas also raises access difficulties for shoppers. Moreover, the price differences between one shopping area and another, and different ranges of goods, all induce shoppers to travel long distances to do their shopping. The response is to seek the fastest and most convenient means of transoportation. Thus, the private car forms the dominant method of transportation to accomplish shopping activity. As shopping areas in Makkah are among the most important activity centres, journeys for shopping are expected to increase as the city population increases. The absence of adequate car parking facilities has resulted in creating severe competition for parking places. These difficulties will become more acute in the future as the city population and car ownership grow.

To control car parking problems at shopping areas, it is recommended that parking meters are installed in adjacent streets. But this should not be the long-term solution. There should be free traffic flow on main city streets which cannot be achieved without an end to kerb parking. Enough parking facilities immediately contiguous to shopping areas and close enough to provide direct pedestrian linkages must be provided. Parking facilities must meet the city population's demand where, from the result of the survey in 1987, 96.7% of shoppers would prefer the creation of parking facilities to end parking difficulties. The vast majority (97%) would prefer multi-storey car parks for reasons that are not clear. Moreover 97% of shoppers are willing to pay parking fees according to the survey held in 1987. In addition to that, we would say that parking facilities should meet the city population demand as well as its non-urban population demand.

To ease congestion en route to shopping area locations, the city planners should re-consider creating new commercial areas in connection with the present development of the city road network. They might create a number of regional centres at key intersections on the third outer circular road (see figure 8.16). This might ease the traffic volume on certain city streets. In case of developing new commercial centres, there should be access points in the parking spaces for trucks to load and re-load goods away from other automobiles. This is particularly necessary in the case of the Halqa, the only wholesale vegetable market, located in the far south part of the city, serving the entire city population, which creates congestion because of the traffic radiating to all parts of the city. Alternative wholesale vegetable markets at various locations in the city would help reduce congestion. Finally, the public transport system should be improved and linked with such markets.

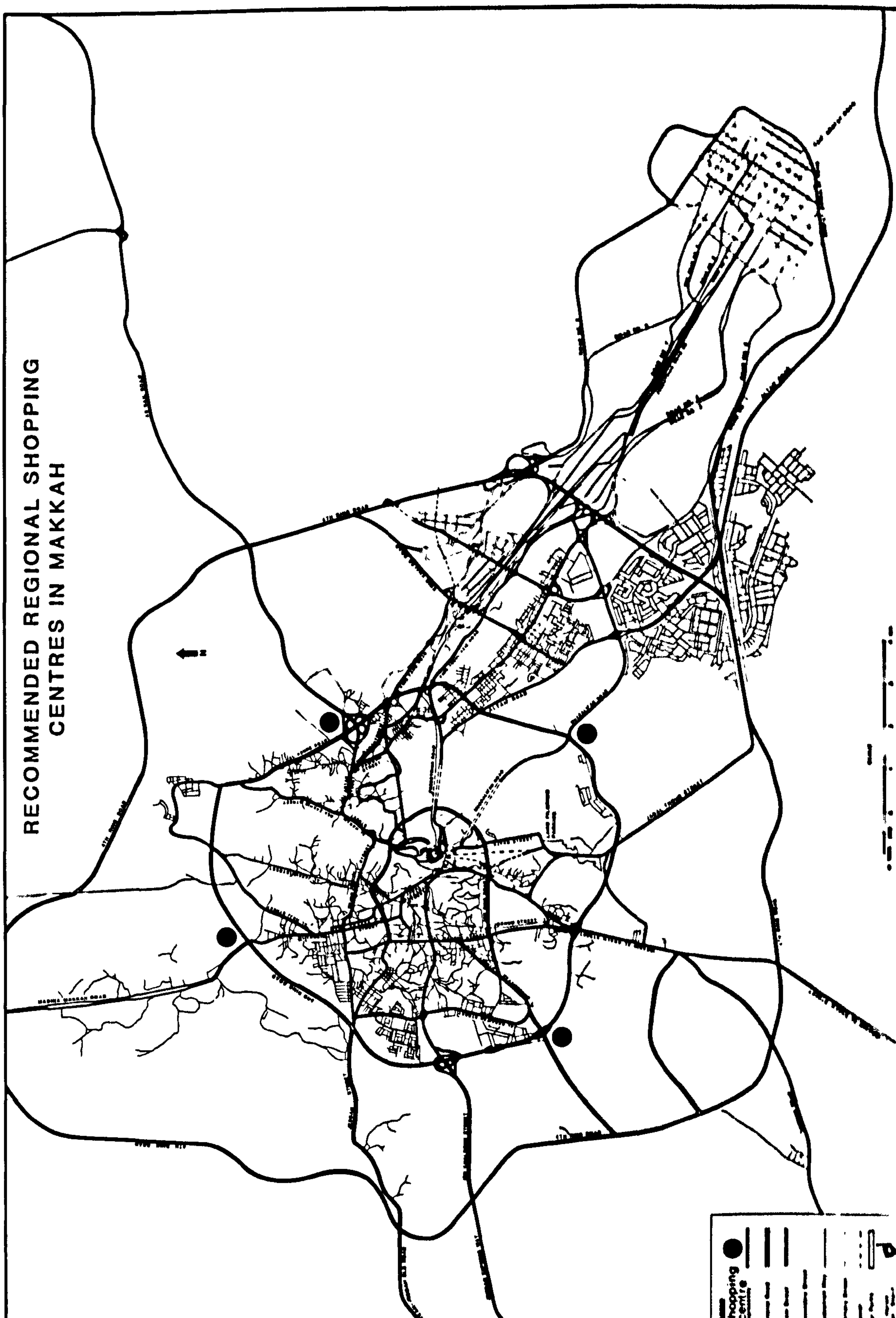

RECOMMENDED REGIONAL SHOPPING
CENTRES IN MAKKAH
Shopping centre

Fig.8.16

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CHAPTER 9

CONCLUSION

9.1 Makkah's Transport Problems

When we come to look at transport problems in Makkah outside the period of Hajj, we find a city which has been subjected to a number of unique influences and factors leading to unusual transport problems. The first of these is its very long history dating from 1892 BC, which was fully discussed in Chapters 1 and 2. Nevertheless it is worth emphasising here that history created a city that was never planned for petrol-driven vehicles or even transport systems dependent upon animals, i.e. commercial and pilgrim caravans, and its morphology is generally unsuitable for mass movement. Therefore, we have a spatial framework which has limitations from the start. Since the emergence of Islam, the city has become the spritual centre of Islam and the focal point for Moslems all over the world. Every Moslem must face the Kaaba for his daily prayers, and everybody must perform Hajj once in his or her life time if able to do so. In addition to that, the city has an extraordinary internal nodality based on Al-Haram, the religious function of which continues throughout the year. Even if there are few visitors to the city, there is always a high demand from the local people who want to pray the five daily prayers in Al-Haram. There is also demand at Friday prayer time and in Ramadan (the fasting month), as well as during the Hajj month, keeping the city centre very busy with continuous traffic, including motor vehicles and pedestrians, day and night, almost every day. So whatever we do about journeys for shopping, to government offices, hospitals, schools and elsewhere, we are still left with the fact that there is a high degree of nodality and there will always be trips generated by Al-Haram not only from the city's local people but also from people of other cities in Saudi Arabia and the rest of the Islamic world.

In addition to the religious role which dominates all other activities the city functions as an administrative centre. Makkah province (Emarat Makkah) is the administrative authority and holds executive power in the whole western region. The headquarters of Makkah province directly controls the various provincial administration distributed throughout the region.

The city plays an important role in education exemplified by Umm Al-Qura university, one of the largest universities in the Kingdom. In addition there is a great variety of different schools for a range of ages scattered throughout the city. Makkah is also a centre for health, social, economic and commercial activities not only for its permanent population (600,000), but also for the surrounding region. People who visit throughout the year, especially during Hajj, also require services of all kinds, which means that there is a tremendous level of traffic converging upon the city, and moving around within it.

The high employment levels in Saudi Arabia, reaching 1,420,000 employees during the third plan period 1400-1405 AH (1980-1985 AD) (1) are especially reflected in a city like Makkah where the place of work creates a big demand for transport and parking facilities. The industrial sector plays an important part in the city's economics and commercial life (2), and also creates a demand for transport not only for employees but for the transportation of new materials to the industrial locations and the distribution of produce to the local and regional markets.

Students, workers and traders all travel in to work at a similar time each day causing a large demand for transport, which keeps city streets busy and congested as in any large modern city. Moreover, high incomes have resulted in high levels of car ownership (see Chapter 3). The region under consideration is very affluent and many families own more than one car, some of whome employ chauffeurs. In addition, the custom of most Saudi women not to ride on public transport or even by taxi creates a huge demand for private transport and parking facilities (see Chapter 8). Besides, any high income community tends to choose to travel by private car whether they are male or female, which aggravates the city transport problems.

In the geographical setting of the city, there are certain physical features which contribute to the transportation difficulties. Modern engineering can assist in alleviating these difficulties, for instance by drilling tunnels, but cannot go all the way in solving them. Due to the extraordinarily hot climate in Makkah, planning along lines that might be followed in a western city is out of the question. The people are different especially with regard to their habits, and also their daily activities which vary according to weather conditions. The transport system has to take into account the heat, because we cannot expect people to walk very far, or to wait a long time at the bus stop, which encourages them to think about owning a private car. Another problem encountered due to the hot weather is that of random parking. It was found during several periods of fieldwork (1985-1986-1987) that the motorist is keen to park close to shops, hospitals, and other institutional buildings. This has resulted in random parking methods, and despite the wide streets this creates congestion and impedes the flow of traffic. This problem has occurred because of the absence of adequate parking facitilies and proper legal controls. Another environmental problem is rainfall, which comes suddenly, and is tropical in character. Because much of the city is located in a valley, drastic floods can cause damage to the city road network and can paralyse traffic.

The exploitation of oil brought vast revenues to the Saudi nation which have provided the opportunity to finance large projects in the Kingdom including urban development. Cities in the Kingdom have generally witnessed great changes, by far the most important of which was the introduction of modern transport systems and linkages between the cities. Makkah has received the most attention from the Saudi government because of its deep religious significance. The building of modern roads connecting Makkah and its region with other regions in Saudi Arabia and neighbouring states, together with the expansion of pilgrim facilities at the sea-port and airport of Jeddah, heralded rapid and vigorous changes to the city. Initial changes were the physical expansion of Al-Haram to cater for its primary religious functions to accommodate more pilgrims at prayers. The physical expansion of the Al-Haram inevitably affected the land-use pattern of the surrounding area and in turn, the city as a whole. The wealth that came from the oil also resulted in major social changes, especially with the coming of the motor vehicle. It has also resulted in high car ownership, population growth, and very rapid physical expansion of the city, with which the city planners and authorities with all their resources can hardly keep pace. To some extent, what we are looking at is the result of the rapidity of change; had the changes occurred more slowly it might have been easier to come to terms with these special problems.

The money spent by pilgrims and other visitors forms a good source of income for Makkah's citizens by renting their houses during Hajj and other significant seasons such as Shaaban and Ramadan. This encourages intensive land use especially in the area around Al-Haram, where tall buildings built close to each other are to be seen, with a large number of tenants because visitors prefer to rent accommodation as near as possible to Al-Haram. The building boom along with the local topography has resulted in a shortage of open spaces required for accommodating motor vehicles. This means therefore that there is no alternative but to use city streets to satisfy demand for parking spaces (see Chapter 6).

The rapid physical expansion of the city resulted in the appearance of peripheral residential areas without the existence of basic amenities, producing a high frequency of trips to reach places where needs can be met. One example discussed is medical services. Hospitals tend to provide the bulk of the medical services in Makkah, rather than doctors' surgeries or smaller clinics which might have spread demand more evenly, so there is a high demand on the available medical services which may be nearing saturation. In addition there is a high demand for parking facilities which cannot be satisfied near the hospitals (see Chapter 7).

A few specialised shopping areas tend to provide services for the local inhabitants as well as city visitors and people who live in the surrounding villages. Therefore a high proportion of trips are generated by a limited number of shops, leading to an imbalance of trip distribution and a high demand for transport and on-street parking facilities (see Chapter 8). The establishment of new residential areas far from the city centre after the city's rapid growth makes it difficult to provide them with adequate public transport services, which in turn reinforces dependency upon private transport. The inadequate bus and taxi services do not reach some of the inner parts of the city and equally encourage private transport. There is a shortage of open spaces not only around the Al-Haram and its surrounding area but also at government offices, hospitals, shopping areas and in residential areas. The existence of tall apartment buildings in residential areas often without garages, has resulted in intensive on-street parking potentially hindering the access of emergency vehicles such as fire engines. Streets taking the form of steps to serve houses on very steep sites are not accessible by motor vehicle, and this causes great difficulty in providing services and access, while their inhabitants own cars and add to the parking pressures on city streets.

Traffic volume on the city's transport network follows a daily pattern. The working day in Saudi Arabia runs from 07.00 to 13.00 during which, unlike western cities, manual workers, business men and traders also return home at the same time and go back again to their work in the evening. The hot weather conditions create such a pattern. The volume of traffic builds up sharply when people travel to work, schools and shops, the peak usually occurring at about 07.00. There is then a fall, with secondary peaks occurring between 09.00 and 12.00 (see Chapter 5). Another peak occurs around 13.00 when people return home from work, schools and shops. A further peak starts to build up at 16.00 when many people go to Al-Haram for religious, shopping, and social purposes. This peak coincides with cooler weather conditions. Another peak occurs in the late evening when people return home. In the month of Ramadan the morning peak is abnormally low because the pattern of activity changes markedly. Usually in Ramadan there is another peak between 17.00 and 18.30

and after that traffic flow falls to its very lowest level. Moving traffic is rarely seen on city streets at the time of prayer. The traffic flow increases once more between 20.00 and midnight, and again between 04.00 and 05.00. Meanwhile, during Hajj the daily traffic volume is higher than in Ramadan and the rest of the year. Also, on Fridays all the year round, traffic volume is high at the time of the Jummah (Friday) prayer at 12.30. Therefore, the city road transport network witnesses remarkable traffic volume variations even on normal days and seasons in connection with the city's religious role, while the pattern of activity changes seasonally through the day because of the effects of the climate.

The regional roads connecting Makkah with other cities in Saudi Arabia have lead to congestion due to through- and terminating traffic. Traffic on regional roads comes into direct contact with local traffic causing complex cross-currents of traffic flow and competition for parking spaces.

For all these reasons, therefore, western city planning perspectives may have rather limited application in the city of Makkah. It is an extraordinary city because of its long history and unique religious role, in addition to its physical geography and social traditions, particularly with respect to the transportation of women. As we have seen, many other local factors are at work. For example the shortage of health services in some parts of the city results in many trips to hospitals in other parts of the city. Thus, while we might try to learn something from other cities, we do not use a lot of theoretical models.

9.2 Recommendations

The transport problems now prevalent in Makkah require solutions, while we must allow for even heavier traffic in future. Thus it is worth making some specific recommendations to alleviate the problem, grouped into six main categories. These are discussed below.

9.2.1 Changing the Pattern of Trip Generation

To reduce road traffic congestion and the impact of the motor vehicle on the city's environment, a number of recommendations are made. While these may not solve the problems, they could ameliorate them considerably.

1 Working hours might be reorganised to alleviate congestion. For example, students could go to their schools at 07.00; government employees could commence work at 07.30 and manual workers could travel last. This would stagger travelling somewhat, and hopefully achieve a more even flow of traffic.

2 Loading and unloading goods at shopping areas should be scheduled at special times during off-peak traffic. Rear unloading spaces for shops is urgently required in the long term to bring the problem to an end.

3 Taxi stands should exist at significant points (for example

close to Al-Haram, hospitals, shopping areas and government offices), in order to make taxi services available for passengers and to reduce the number of journeys made by taxi drivers looking for passengers. Taxi services at such points could involve specialist companies.

4 Relocating certain government offices on sites having direct access to ring roads would help to achieve a more balanced traffic flow and ease the pressure of using side streets penetrating several crowded neighbourhoods.

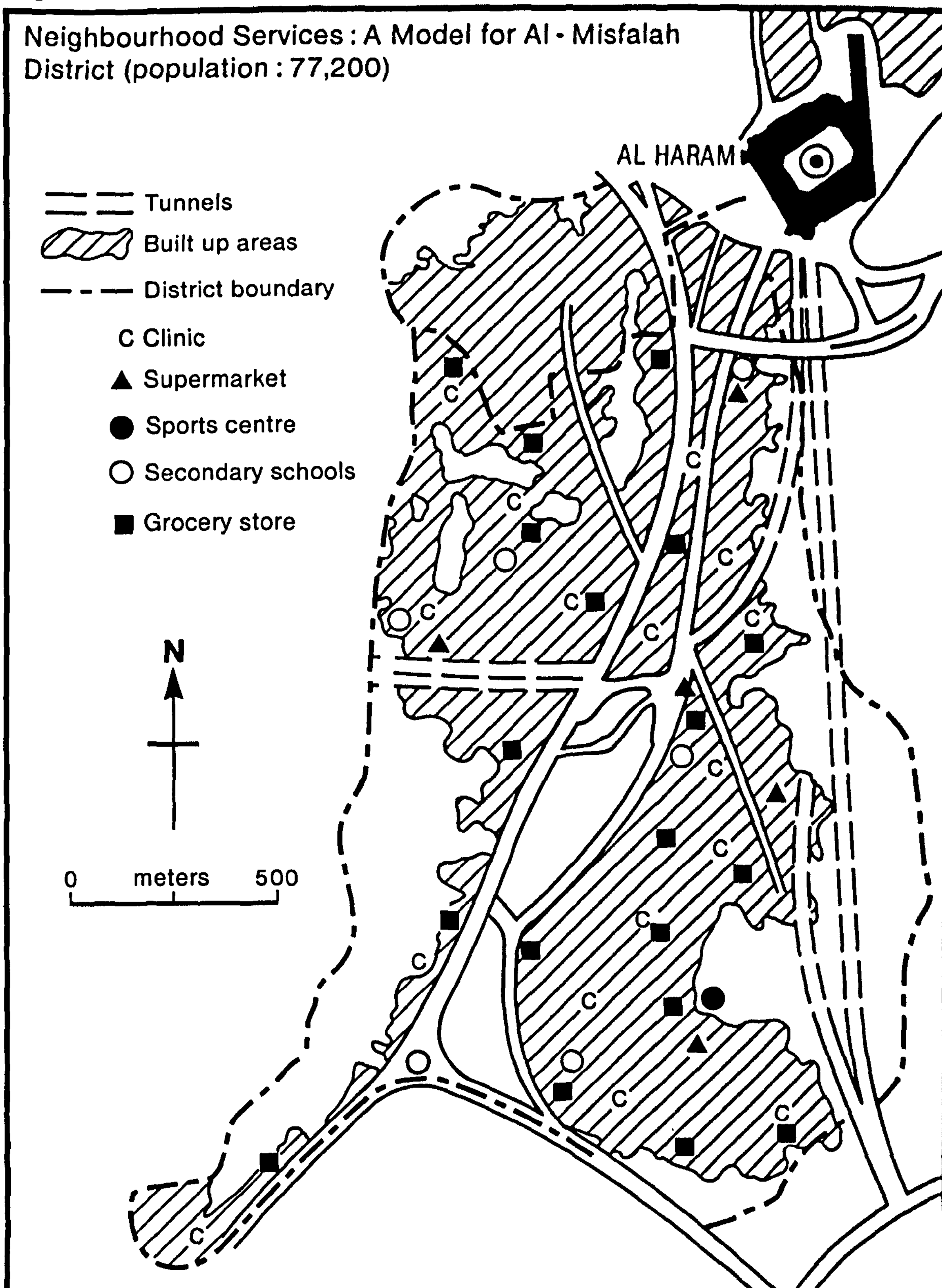
For the long-term future, long distance internal urban trips could be almost eliminated by selecting geographically rational locations for basic services, for example:

5 Neighbourhood clinics should be established, so they could be reached within approximately ten minutes' walk. For example, Al-Missfalah district with a population of 77,200 might need a total of 16 clinics, each one providing basic health services for 5,000 people.

6 Neighbourhood grocery shops should be provided, especially in those districts recently established which lack such services.

7 The distribution of neighbourhood services could eventually comprise other services such as schools, nursery schools and sports centres (see Fig. 9.1).

Fig.9.1


Neighbourhood Services : A Model for Al - Misfalah District (population : 77,200)
AL HARAM
Tunnels
Built up areas
District boundary
C Clinic
Supermarket
Sports centre
Secondary schools
Grocery store
N
0
meters
500

9.2.2 Improved Transport Management

In addition, a number of recommendations may be made which could contribute considerably to better traffic management. These are:

1 To adopt more one-way systems on very congested roads.

2 To forbid U-turns on busy city streets, to speed the traffic flow and lessen the frequency of stops and starts.

3 Kerb-side parking should be controlled or forbidden on major roads.

4 All traffic should be restricted from entering the Al-Haram area, except in the case of emergency services and possibly public transport.

9.2.3 Road Improvements and Engineering

Two recommendations are made:

1 High-capital engineering solutions should be carried out to solve the severe traffic congestion at the meeting point of Al-Shubikah bridge (from the north west of the city) with Umm Al-Qura street (from the west parts of the city) as well as traffic coming from the Jeddah expressway towards Al-Haram. From both directions a total of six lanes carrying traffic currently narrows down to three lanes, without even the help of traffic lights. Further on from that meeting point another conflict could arise where there are pedestrians mingling with motor vehicles going to Al-Haram especially where some motorists turn in the direction of Al-

Missfalah district, which can seriously interrupt the traffic flow going to Al-Haram.

2 Traffic flow coming from regional expressways towards Al-Haram area should be re-routed and segregated from local traffic by using ring roads in order to avoid interference with the local traffic.

9.2.4 Improved Public Transport Services

There is no doubt that the private car is still the most popular means of transport in Makkah, because it can be used by the owner when desired. But energetic attempts should be made to encourage the use of public transport which must have an important role to play in Makkah's future transport planning. This cannot be achieved unless the public transport services are much improved and better organised. A number of suggestions to improve the public transport services in Makkah can be made:

1 An adequate number of buses should be provided to satisfy the demand for transportation, especially at peak times.

2 Lanes should be reserved for buses to achieve speed and keep services to a fixed time-table.

3 Offering lower fares for students, and season rates for regular customers.

4 Mini-buses should be used where streets are narrow and long buses cannot penetrate. In addition, mini-buses could be used as feeders for the main public transport network.

5 As the climate in the city is very hot, bus shelters should be adequate and all buses must be air-conditioned.

6 Integrated schemes should be established between private transport and the public transport systems, along the lines of "park and ride".

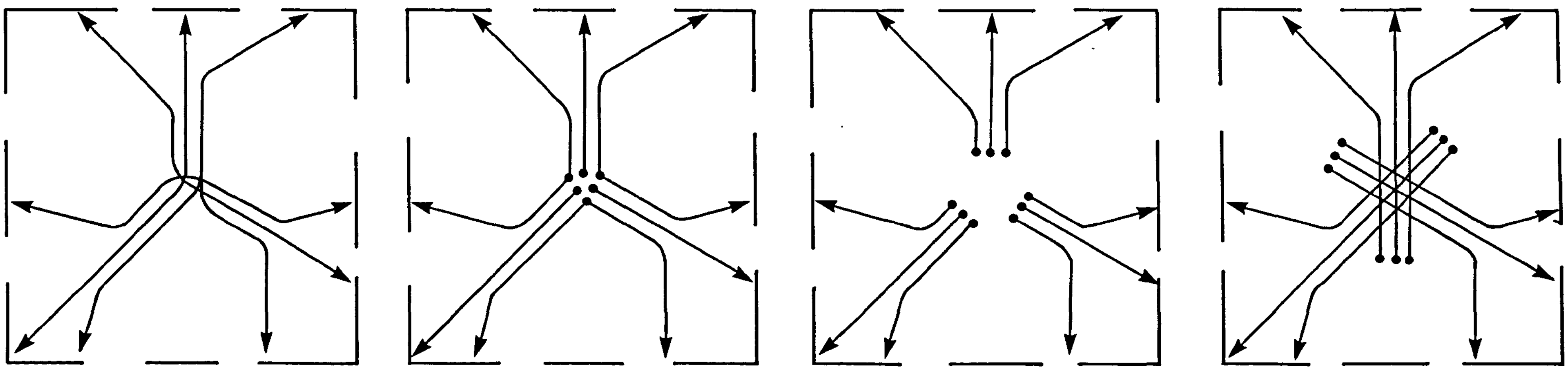
7 As the opportunity for jobs for women will be much increased in the fourth Five Year Plan 1985-1990 (3), there will be a demand for female transport, and women should therefore be encouraged to use mini-buses which specialise in transporting working women. Routes of such buses should serve the inner parts of the city districts as well as the main public transport network, thus making the use of public buses far more attractive to women.

8 As there is no direct contact between city districts by public transport services, bus stations are required at intersecting points.

9 The public transport company should implement new routing strategies in the central area, possibly by adopting one or more of the routing strategies as shown in Figure 9.2. For instance the nearside terminating strategy could be an ideal one if the suggestion of restraining traffic around the Al-Haram area is implemented (see Fig. 6.10).

10 Public transport facilities should be provided between the city of Makkah and villages located around it. This would help reduce the use of the private car, especially for those working in the city.

Fig.9.2 BUS ROUTEING OPTIONS IN A TOWN CENTRE



crosstown central terminating nearside terminating farside terminating

SOURCE: Suzanne Hinton, 1981, Urban Planning and Design for Road Public Transport, Confederation of British Road Passenger Transport, London. P.55

11 To make taxi services more reliable and convenient, a dial-a-taxi system should be adopted, and the city municipality shoud number houses and provide detailed maps showing each area in the city, enabling the taxi driver to find his way easily. If such organisation could be achieved, the taxi would enjoy some of the private car's flexibility by providing door-to-door journeys, 24 hours a day.

12 For large families (five to more than seven) who have no car and who require to travel together, it would be useful to provide large taxis with seating for more than four or five psassengers, offering door-to-door services by following the same dial-a-taxi method. If this type of taxi service was established, its benefit would be high, certainly with regard to solving the problem of transporting families together.

9.2.5 Car Parking Provision

It is obvious from the discussion of car parking demand that it is great, but that shortage of open space makes it difficult for the city to cater for a demand and it will require ingenious solutions and the establishment of new policies to solve the problem.

A number of solutions can be suggested to relieve car parking problmes around Al-Haram, such as building multi-storey car parks, underground car parks and a canti-park system. However, more car parking facilities mean that yet more drivers are likely to join the competition to drive toward Al-Haram, thus adding to the traffic volume. The conflict between pedestrians and motor vehicles will become more acute bringing worse congestion and raising traffic noise and pollution to critical levels. This is a closely built-up area where air does not circulate well, which can result in serious environmental hazards affecting health, and historic buildings (see Chapters 5 and 6). Thus, restricting traffic entering the Al-Haram area and providing parking facilities away from it, such as "park and ride", appears to be the only way of segregating the motor vehicle from pedestrians and avoiding excessive congestion (see Chapter 6).

To end the effect of on-street parking at hospitals and government offices, parking facilities should be created as far as possible in order to clear city streets for traffic flow. To solve parking problems in residential areas two suggestions may be made. Firstly, the ground level of houses should be compulsorily left for garaging. Secondly, no more permission should be given to build houses on very steep sites because of the access difficulty and the aggravation of car parking problems on city streets (see Chapter 6).

Kerb-side parking in shopping areas must be stopped by providing alternative off-street parking facilities. However, this may require the demolition of houses, and here serious difficulties could arise as to who would pay for such a project.

In addition to that, house owners would clearly be reluctant to accept the idea and abandon their houses. The land value and high profit they get from renting their buildings are clearly factors which affect the decision of owners in not moving away. Compensation would be very costly, so the problem of car parking in shopping areas remains critical.

Existing out-of-city markets should be re-designed by the city planners. Traders might participate partly or completely in the reconstruction of such markets. Out-of-city markets should be linked by easy access to ring roads, provided with sufficient car parking facilities (see Fig. 8.6), and linked by public transport (i.e. shuttle buses from districts in the city centre to the location of the market). If this suggestion is implemented, congestion could be relieved by redirecting some of the traffic flow for shopping purposes through the ring roads. If regional markets existed on the city fringe another benefit might be the segregation of local traffic from traffic coming from local villages for shopping.

9.2.6 A Rapid Transit System

Finally, the city authorities should set up a rapid-transit system, similar to the Newcastle upon Tyne (U.K.) Metro system. Transport problems in Makkah in the future cannot be solved only by private transport as the population will increase and the city is expected to expand, and the demand for public transportation will inevitably increase. One system which could be implemented is an underground metro system. An example of such a system is the Metro in Cairo, Egypt, which came into operation in September 1987 [4]. Cairo experiences severe and complicated transport problems [5] associated with a population of 11.1 million [6] which it is estimated will increase to 16.9 million by the year 2000 [7]. The Cairo Metro already serves both the city itself and Greater Cairo (see Fig. 9.3) and will have a major impact in reducing the city's acute transport problems [8]. Cairo authorities and transport consultants are expecting that a number of immediate benefits can be achieved from operating the Metro. Similar advantages might accrue from a metro system in Makkah. These benefits can be summarised as follows [9]:

1 Noise and pollution from the heavy use of motor vehicles can be reduced to an acceptable level.

2 Some 22,000 lost working hours, resulting from congestion and delay, will be saved daily by transporting employees conveniently and efficiently by metro.

3 The conflict between pedestrians and motor vehicles in the city centre will be alleviated by absorbing some pedestrian flow under the ground level.

4 The acute car parking problem in central Cairo could possibly be brought to an end by creating car parking facilities away from the city centre and encouraging motorists to use the metro if they are travelling in the direction of the city centre.

Fig.9.3

Source:Egyptian embassy London 1988

9.3 Priorities

It is evident from this study that Makkah has developed almost to the size and complexity of a metropolis, and is expected to grow further as its population grows (see Chapters 1 and 2). From the fieldwork survey, it was found that car ownership is high and use of the car contributes to trip generation for various purposes (see Chapter 3). This results in heavy use of the city roads, traffic congestion, road traffic accidents, noise, and air pollution (see Chapter 5).

From fieldwork, it is also clear that the inadequate public transport services and high fares are a major frustration for bus passengers, and priority should be given to cheaper and more adequate public transport. Furthermore, it was evident that the physical geography and the intense city land-use lead to a severe shortage of open spaces suitbale for car parking (see Chapters 6, 7 and 8). At the same time there is a lack of basic services in many outlying parts of the city, leaving no choice except long distance travel for many citizens (see Chapters 7 and 8). All these difficult problems must not be neglected, and a series of priorities for action must be urgently established. These might be seen as follows:

A **Short-term measures**

Mini-buses

More public buses

Taxi stands

Park and ride systems

Restriction of traffic access to Al-Haram area

Segregation of regional traffic to the city and local traffic

Re-routing buses in the city centre

B Medium Term Action

Neighbourhood shops and stores

Neighbourhood clinics, schools, sports centres etc.

More ring roads

Compulsory ground-level garages in apartment blocks

Stricter car parking control in the city

Provision of under-ground parking space at key institutions and buildings

C Longer Term Projects

Rapid transport metro system

Relocation of government offices

Out of town shopping centres

9.4 Further Research

It became clear that further research must be done on the appropriate design and distribution of health and education establishments by following scientific criteria of transport needs in relation to demand. The appropriate system of rapid-transit should be studied carefully and should be relevant to the local residents as well as the requirements of visitors. Traders and businessmen's participation in shopping area projects is a new idea which needs to be evaluated. More detailed scientific research should be carried out to study the impact of motor vehicles on the city environment and the health of people.

In addition to all that has been said before, the trends of trip generation and how they may change in future should be studied; if, for example, the present increase in the costs of fuel, motor vehicle prices and taxation continue markedly, travel habits could change in response [10]. Moreover, Saudi society is in the middle of social change which should be more carefully monitored when plans for future transport systems are drawn up. Changes in transportation in Makkah are sure to occur; the challenge will be to make those changes as rational as possible.

9.5 References

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APPENDICES

Makkah Household Interview

1. Place of interview ....

2. House number ....

3. Number in household ....

4. Could we know your monthly income level? (Please tick one box)

   1. Less than 1000 ☐
   2. From 1000 to less than 2000 ☐
   3. From 2000 to less than 3000 ☐
   4. From 3000 to less than 4000 ☐
   5. From 4000 to less than 5000 ☐
   6. From 5000 to less than 6000 ☐
   7. From 6000 to less than 7000 ☐
   8. From 7000 to less than 8000 ☐
   9. From 8000 to less than 9000 ☐
   10. More than 9000 ☐

5. Nationality ....

6. Age ....

7. Sex ....

8. Occupation ....

9. Place of work ....

10. Place of school ....

11. Origin and destination of all trips made yesterday by each number of the household (extra sheet to be used if necessary):

Origin Street/ house	Origin District	Purpose at Origin	Desti-nation Street/ house	Desti-nation District	Purpose at Desti-nation	Method of Trans-port	Journey Time

Purpose at Origin & Destination

1. Home
2. Residence
3. Personal
4. Social
5. Private
6. Work
7. Shopping
8. Religious
9. School
10. Others please specify:

Makkah : Transportation Survey 1984-5.

Trip Characteristic Survey

Roadside/interview field sheet

Name of Interviewer ....

Name of Supervisor ....

Day and Date ....

Origin Location if Outside Makkah	Purpose at Origin	Destination Location if outside Makkah	Purpose at Destination	Mode	Anticipated arrival time

Interview with bus passengers:

Transportation Survey, Makkah : 1405 A.H.

Date & Day ....

Trip arriving time ....

Location & Number of the check point ....

Name of District ....

Interviewer name ....

Supervisor's name ....

1. Where did you start this journey? Please tick:

   a) Home ☐

   b) Work ☐

   c) Other please specify: ....

   ....

2. How long did you take to get to the bus stop? ....

3. Duration of waiting time at origin time ....

4. What is the distance between your house and the nearest bus station? ....

5. When did you take the bus? ....

6. Do you think the bus service is? Please tick:

   a) Very satisfactory ☐

   b) Satisfactory ☐

   c) Not satisfactory ☐

   d) Others please specify: ....

   ....

7. What is the main dissatisfaction? Please specify: ....

....

8.

Origin Location	Purpose at origin	Destination Location	Purpose at Destination	Do you plan to continue somewhere else	To where do you plan to continue

9. Travel time from origin to destination is; Please tick:

a) Very satisfactory ☐

b) Satisfactory ☐

c) Not satisfactory ☐

d) Others please specify: ....

....

10. Problems you face at the bus station; Please tick:

a) Bus not arriving on time ☐

b) No shelter provided to protect from sun ☐

c) Travel information ☐

d) All of the above ☐

e) Others please specify: ....

....

11. Comments:

APPENDIX D

Car Park Survey

The purpose of this survey is:

i) To examine the capacity of the car park and to ascertain the actual number of cars which occupy it.

ii) To know whether the car park capacity copes with the demand.

iii) To identify the peak times throughout the day and the week and the extent of under-capacity at peak periods.

Interview Car Park Users

City of Makkah - 1405 A.H.

1. Place of interview: ....

2. Name of car park and location: ....

3. Time: ....

4. Capacity of car park and number of storeys: ....

5. Number of passengers in vehicle: ....

6. Place of origin: ....

7. Distance between the car park and the place of origin; Please tick

    1. Less than 1 km. ☐

    2. From 1 km to 2 km. ☐

    3. From 2 km to 3 km. ☐

    4. From 3 km to 4 km. ☐

    5. From 4 km to 5 km. ☐

    6. From 5 km to 6 km. ☐

    7. From 6 km to 7 km. ☐

    8. From 7 km to 8 km. ☐

    9. From 8 km to 9 km. ☐

    10. From 9 km to 10 km. ☐

    11. More than 10 km. ☐

8. Purpose of coming; Please tick:

   1. Shopping ☐

   2. Praying ☐

   3. Work ☐

   4. Others please specify: ....

   ....

9. Duration of parking time: .... hour(s)

   .... day(s)

10. How frequently do you stop your car at this car park?

   ☐ Daily average

   ☐ Once a week average

   ☐ Once a month average

11. Problems you face in the car park; Please tick:

   1. Number of places available ☐

   2. The speed of movement ☐

   3. Ticket system ☐

   4. Access to parking space ☐

   5. Security within the car park ☐

   6. Services are not sufficient such as:

      a) Elevation ☐

      b) Cafeteria ☐

   7. Other problems: please notify: ....

   ....

12. Would you pay more for better services? ....

13. Destination after leaving by vehicle ....
(Name of area of Makkah)

14. Purpose of going to that destination:

    1. Home ______

    2. Other please notify: ....

    ....

15. Other comments:

APPENDIX E

Survey of Car Park at Hospitals and Traffic Problems

The purpose of this survey is:

i) To examine the adequacy of the hospital car parks.

ii) To analyze the traffic congestion around hospitals.

iii) To know whether the public transportation services can cope with hospital visits.

iv) To reach recommendations to solve the problems.

Survey of car park at hospitals and traffic problems, Makkah - 1405 A.H

1. Name of hospital and its location ....

2. Place of origin ....

3. How do you come to hospital (Mode)? Please tick the chosen number:

   a) Private car ☐

   b) Taxi ☐

   c) Friend's car ☐

   d) Bus ☐

   e) Other please specify: ....

4. Do you think the public transportation is: Please tick the chosen number:

   a) Very satisfactory ☐

   b) Satisfactory ☐

   c) Not satisfactory ☐

   d) Don't know ☐

5. What is the main dissatisfaction? ....

   ....

6. What is the distance between your house and this hospital? Please tick:

   a) Less than 1 km ☐

   b) From 1 km to 2 km ☐

   c) From 2 km to 3 km ☐

d) From 3 km to 4 km ☐

e) From 4 km to 5 km ☐

f) From 5 km to 6 km ☐

g) From 6 km to 7 km ☐

h) From 7 km to 8 km ☐

i) From 8 km to 9 km ☐

j) From 9 km to 10 km ☐

k) More than 10 km ☐

7. Travel time from origin to hospital ....

8. When did you park your car? ....

9. How far is this from the hospital? ....

10. Car park facilities; Please tick:

a) Very adequate ☐

b) Adequate ☐

c) Inadequate ☐

d) Non-existent ☐

11. What do you think about the road signs to the hospital? Please tick:

a) Very adequate ☐

b) Adequate ☐

c) Inadequate ☐

d) Non-existent ☐

12. Did you find the journey to hospital? Please tick:

a) Very easy ☐

b) Easy ☐

c) Difficult ☐

d) Others; Please specify: ....

13. What was the main difficulty that you had? Please specify: ......

....

....

14. Other comments:

APPENDIX F

MAKKAH TRANSPORTATION SURVEY 1405 A.H.

PARKING SURVEY: FIELD SHEET

Name of Counter ....

Name of Supervisor ....

Day and Date ....

Hourly Count ....

Starting ....

Parking Zone ....

REGISTRATION NUMBER	Type of vehicle				Method of Parking		
	Car	Taxi	Truck	Bus	Proper parking	Double or blocking	In no-parking zone

Parking in shopping areas survey

MAKKAH TRANSPORTATION SURVEY 1405 A.H.

Name of Supervisor ....

Day and Date ....

Hourly Count ....

Starting ....

Parking Zone ....

TIME	Type of vehicle				Method of Parking		
	Car	Taxi	Truck	Bus	Proper parking	Double or blocking	In no-parking zone
8.00 to 9.00							
9.00 to 10.00							
10.00 to 11.00							
11.00 to 12.00							
12.00 to 13.00							
13.00 to 14.00							
14.00 to 15.00							
15.00 to 16.00							
16.00 to 17.00							
17.00 to 18.00							
18.00 to 19.00							
19.00 to 20.00							

APPENDIX G
Shopping Survey

The purpose of the Survey

1. To know the habits of shoppers going to shopping areas.

2. To know the most dominant method of transportation used to shopping areas.

3. To know whether there is a problem to find parking places at shopping areas and shops.

4. To know the time that people go out for shopping.

5. To uncertain problems that face shoppers while going go to shopping areas whether on foot, Private Car, Taxi or Bus.

1. Date .... 2. Time ....

3. Sex (please tick) A. Male [ ] B. Female [ ]

4. Age (please tick)
   1. From 18-20 years [ ]
   2. From 21-40 years [ ]
   3. More than 40 years [ ]

5. Please name the living district of residence ....

6. When was the last time you were at the Market? (Please tick)
   1. Today [ ]
   2. Yesterday [ ]
   3. At the beginning of this week [ ]
   4. Weekends [ ]
   5. Last week [ ]

7. Would you please mention the name of the last Market you visited?

   ....

8. How frequently do you go for shopping during the week? (Please tick)
   1. Every day [ ]
   2. From 4 to 6 times [ ]
   3. 3 times during the week [ ]
   4. Twice a week [ ]

5. Once a week ☐

6. Only weekends ☐

9. What is the best time to go to Market? (Please tick)

1. Morning ☐ 2. Evening ☐

10. Do you go to more than one Market on the day of shopping? (Please tick)

1. Yes ☐ 2. No ☐

11. How much time do you usually spend at each Market? (Please tick)

1. From 15 to less than 30 minutes ☐

2. From 30 to less than 60 minutes ☐

3. From 60 to less than 90 minutes ☐

4. From 90 to less than 120 minutes ☐

5. From 120 to less than 150 minutes ☐

6. More than 150 minutes ☐

12. Would you please mention Markets that you usually go to? (Please specify)

1. .... 2. ....

3. .... 4. ....

5. .... 6. ....

13. If you go to one Market, would you please mention for what reason you choose it? (Please tick)

1. Market near home ☐

2. Get all my needs ☐

3. To avoid heavy traffic ☐

4. All of the shove ☐

14. If you go to more than one Market, for what reason? (Please tick)

1. I do not find my needs ☐

2. Price differences ☐

3. Easy journey ☐

4. All of the shove ☐

15. What method of transport do you use to go shopping? (Please tick)

1. Private Car ☐

2. Private Car with driver ☐

3. Private Car with Husband ☐

4. Private Car with son ☐

5. Taxi ☐

6. Bus ☐

7. Motor Cycle ☐

8. On foot ☐

16. If you go to Market by Private Car with driver, does the driver wait for you? (Please tick)

1. Yes ☐ 2. No ☐

17. Why do you prefer going to Market by Private Car? (Please notify)

....

....

18. Why do you prefer going to Market by Bus? (Please notify) ....

....

....

19. How do you find the journey to Market? (Please tick)

1. Very easy ☐

2. Easy ☐

3. Difficult ☐

4. Very difficult ☐

20. Do you face transport problems en route to shopping areas? (Please specify):-

1. ....

2. ....

3. ....

4. ....

21. Do you face parking problems at shopping areas? (Please tick)

1. Yes ☐ 2. No ☐

22. Do you prefer shopping centres with parking facilities? (Please tick)

1. Yes ☐ 2. No ☐

23. If yes, do you prefer multi-storey car parks? (Please tick)

1. Yes ☐ 2. No ☐

24. Are you willing to pay parking fees? (Please tick)

1. Yes ☐ 2. No ☐

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Produced and Published by

1983-1984

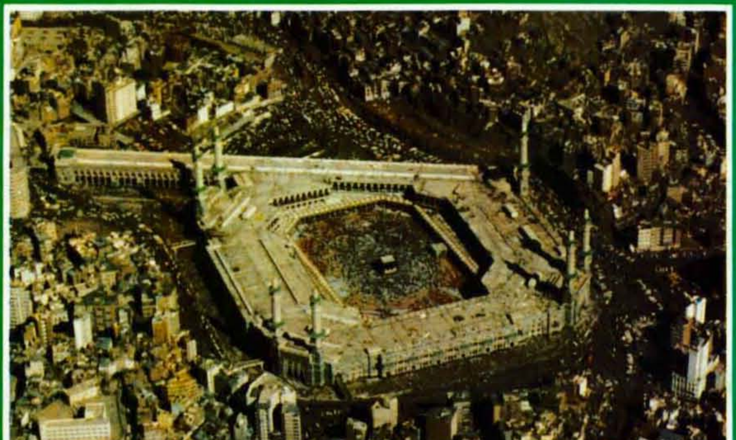
CITY MAP and Hajj Guide of MAKKAH AL MUKARRAMAH

بسم الله الرحمن الرحيم

خريطة مكة المكرمة والمشاعر ودليل الحاج

١٤٠٣ - ١٤٠٤ هـ

انتاج ونشر
المهندس زكي محمد علي فارسي



المهندس زكي محمد علي فارسي
ص . ب ٧١١٤
جدة - المملكة العربية السعودية
ت: ٦٦٥٩٨٧١ - ٦٦٧٥٤٤١ تلكس: ٤٠٢٩٤٩ ZFARSI SJ

Telephone Numbers of Services			تلفونات الخدمات
1 Directory Enquiry	905	٩٠٥	١ الإستعلامات
2 Operator	900	٩٠٠	٢ المكالمات الدولية
3 Police (Rescue)	999	٩٩٩	٣ شرطة النجدة
4 Fire Department	998	٩٩٨	٤ الدفاع المدني
5 Ambulance	997	٩٩٧	٥ الإسعاف
6 Traffic Accidents	993	٩٩٣	٦ حوادث المرور
7 Phone Maintenance	904	٩٠٤	٧ صيانة التلفون
8 Telex Maintenance	930	٩٣٠	٨ صيانة التلكس
9 Saudia Airlines	5433333	٥٤٣٣٣٣٣	٩ الخطوط السعودية
10 Airport Information	(02) 6842000	(٠٢) ٦٨٤٢٠٠٠	١٠ استعلامات المطار
11 Electricity	5741022/23/24	٥٧٤١٠٢٢/٢٣/٢٤	١١ شركة الكهرباء
12 Water	5452240	٥٤٥٢٢٤٠	١٢ مصلحة المياه

Roads in Makkah — الشوارع في مكة المكرمة

Abdullah Bin Az Zubayr St	14R
Ajyad St	15H
Al Abtah St	20U
Al Ashre Road	20W
Al Aziziyah St	23H
Al Hajj St	9W
Al Hujun St	10U
Al Jazair St	12V
Al Mansur St	8T-9L
Al Mansuriyyah St	6G
Al Masjid Al Haram St	16S
Al Munhana St	21T
Al Tanelm St	8V
Altaif Road	24D/21K
Ar Rasaifah St	6J
Ar Rawdah St	20T
Arafat Circular Road	30B/31A
As Sail Road	23W/28Y
Ibn Khaldoun St	3K/7P
Ibrahim Khalil St	6A/8D
Jabal Al Kaabah St	10R
Jabal Thour St	12F/18D
Jeddah Express Way	1H
Jeddah St	4U/6T
Jorhum St	9G
King Abdul Aziz Bridge	25H
King Abdul Aziz Road	23L
King Fahd Road	24 M
King Faisal Bridge	27F
King Khaled Road	24H
Madina-Makkah Road	6Z
Makkah-Jeddah Old Road	2R
Muzdalifah Road	24E
Pedestrian Road	20N
Qasr Al Diafah St	6U
Rez Zahir St	18V
Souq Al-Arab Road	25J
Taif-Ararat Road	32A
Yaman Road	4B-6B
2nd Ring Road	10J
3rd Ring Road	5H/6V
4th Ring Road	4E/16Z

Index — فهرست

Mosques — المساجد

1 Al-Haram Ash-Sharif	14N	١٤ ش	١ المسجد الحرام
20 Al-Bay'ah Mosque	23P	٢٣ ص	٢٠ مسجد البيعة
21 Al-Khaif Mosque	24K	٢٤ ر	٢١ مسجد الخيف
22 Al-Omrah Mosque	7X	٧ ك	٢٢ مسجد العمرة
23 Mina Mosque	26K	٢٦ ر	٢٣ مسجد منى
24 Namera Mosque	30/31B	٣٠-٣١ ب	٢٤ مسجد نمرة

Historical Sites — المواقع التاريخية

17 Jabal Al Nour	22W	٣١ ب	٢٥ جبل الرحمة
25 Jabal Al Rahmah (Mercy Mountain)	31B	٢٢ ق	١٧ جبل النور
18 Jabal Thour	20E	٢٠ ج	١٣ جبل ثور

أرقام الهاتف بين (قوسين) يليها مرجع الخريطة
Telephone Numbers are in Brackets ( ) followed by the Map Reference.

Public & Government Agencies — المصالح الحكومية والأهلية

7 Court (Supreme)	(5564469)	23G
10 Civil Defence Dept. for Hajj	(5589586)	24G
12 Civil Defence (Al Aziziyyah)	(5563697)	24G
35 General Security Communication Office	(5564911)	23G
36 Girls Education Administration	(5562121)	24F
40 Islamic Court	(5563811)	22P
42 Islamic World League	(5744288)	24J
47 Min. of Defence (Police Army)	(5740520)	9R
63 P.T.T. Saudi Tele. (Al Aziziyyah)	(5585601)	21N
78 Municipality for the 7th Zone (Al-Aziziyyah)	(5564491)	24G
103 Royal Palace	(5587110)	15N
106 Scouting Permanent Camp		22J
107 Social Affairs Service Centre	(5563452)	22P
120 Ummul Qura University	(5562524)	23H
123 Al Wehdah Sporting Club	(5426047)	7Y
124 Emergency Police Centre	(5433411)	24J
126 General Security Office in Mina	(5564910)	24J
127 Government Depts. (Emirate-Police-Municipality)		18U
128 Government Guests Buildings		24H
129 Holy Kaaba Drape Factory	(5425650)	3S
131 Intercontinental Hotel	(5434455)	4U
132 Islamic Conference Hall	(5434054)	4T
134 Makkah Electricity Station	(5747309)	7Y
135 Min. of Pilgrimage & Awagaf	(5562290)	24K
136 Min. of P.T.T. (Saudi Tele. Dept.)	(5424100)	6Z
138 Municipality in Mina for Hajj Season		24K
140 Public Transportation Company	(5425300)	6Z
141 Reserved Army Dept.	(5586625)	22L
142 Slaughter Houses	8C, 27M,	26H
144 Sport City		31Z

١٢ بلدية المنطقة السابعة	(٥٥٦٤٤٩١)	٢٤ خ
١٨ الأمن العام (وحدة الاتصالات)	(٥٥٦٤٩١١)	٢٣ خ
٢٠ ادارة تعليم البنات	(٥٥٦٢١٢١)	٢٤ ح
٢٢ جامعة ام القرى	(٥٥٦٢٥٢٤)	٢٣ د
٢٦ مركز الخدمة الاجتماعية	(٥٥٦٣٤٥٢)	٢٢ ص
٣٠ قيادة الدفاع المدني لشئون الحج	(٥٥٨٩٥٨٦)	٢٤ خ
٣١ مركز دفاع مدني العزيزية	(٥٥٦٣٦٩٧)	٢٤ خ
٤١ رابطة العالم الاسلامي	(٥٧٤٤٢٨٨)	٢٤ ذ
٦٣ القشلة (قيادة الشرطة العسكرية)	(٥٧٤٠٥٢٠)	٩ ط
٦٤ القصر الملكي	(٥٥٨٧١١٠)	١٥ ش
٩٢ محكمة التميز	(٥٥٦٤٤٦٩)	٢٣ خ
٩٤ المحاكم الشرعية	(٥٥٦٣٨١١)	٢٢ ص
٩٥ المعسكر الكشفي الدائم		٢٢ ذ
١١١ الهاتف السعودي (بالعزيزية)	(٥٥٨٥٦٠١)	٢١ ش
١٢٣ ادارات حكومية (امارة - امانة - شرطة)		١٨ غ
١٢٤ الادارة العامة للمجاهدين	(٥٥٨٦٦٢٥)	٢٢ ز
١٢٥ الأمن العام بمنى	(٥٥٦٤٩١٠)	٢٤ ذ
١٢٦ انتركونتننتال (فندق)	(٥٤٣٤٤٥٥)	٤ غ
١٢٩ بلدية منى في موسم الحج		٢٤ ر
١٣٠ شرطة الطوارىء	(٥٤٣٣٤١١)	٢٤ ر
١٣١ الشركة السعودية للنقل الجماعي	(٥٤٢٥٣٠٠)	٦ م
١٣٣ الضيافة الحكومية بمنى		٢٤ د
١٣٤ قاعة المؤتمر الاسلامي	(٥٤٣٤٠٥٤)	٤ ع
١٣٦ كهرباء مكة	(٥٧٤٧٣٠٩)	٧ ل
١٣٧ مجازر ومحارق بمنى ومكة		٨ ت، ٢٦ د
١٣٨ المدينة الرياضية		٢٧ س
١٣٩ مصنع كسوة الكعبة	(٥٤٢٥٦٥٠)	٣ ظ
١٤١ نادي الوحدة	(٥٤٢٦٠٤٧)	٧ ل
١٤٣ وزارة البرق والبريد والهاتف (ادارة الهاتف السعودي)	(٥٤٢٤١٠٠)	٦ م
١٤٤ وزارة الحج والاوقاف بمنى	(٥٥٦٢٢٩٠)	٢٤ ر

Hospitals & Medical Centres — المستشفيات والمراكز الطبية

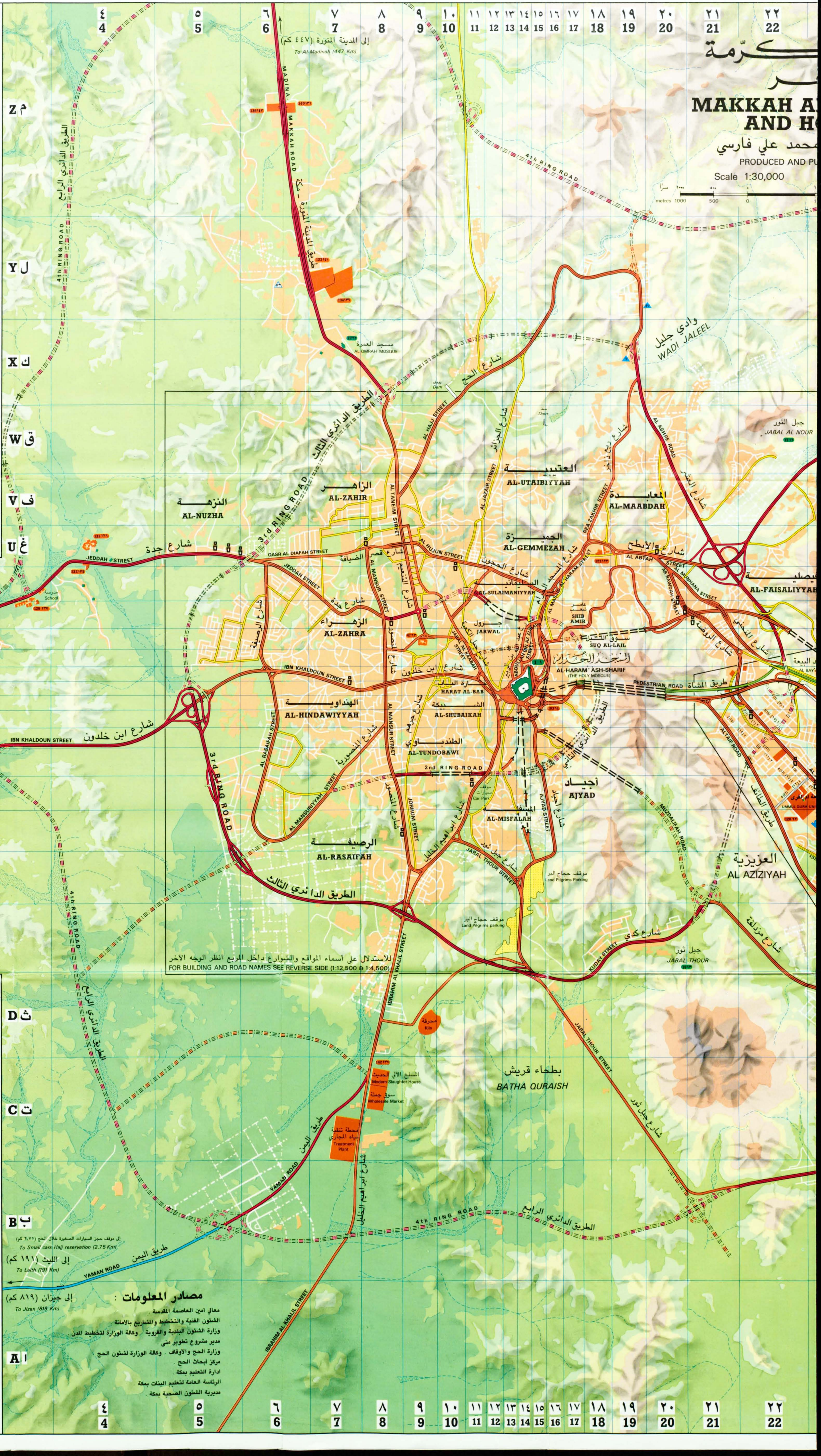
2 Al-Aziziyah Dispensary	(5564412)	23H
14 General Hospital, Mina	(5563502)	23H
15 Mina Dispensary No.1	(5562702)	24K
16 Mina Dispensary No.2	(5562468)	24K
17 Mina Dispensary No.3	(5562579)	25H
18 Mina Dispensary No.4	(5562302)	25H
19 Mina Dispensary No.5	(5562302)	25H
20 Mina Dispensary No.6	(5562302)	25J
21 Mina Dispensary No.7	(5562302)	25L
22 Saudi National Hospital	(5562177)	23H

Pharmacy — الصيدليات

45 Al Aziziyah Pharmacy	(5562042)	23H

Banks — البنوك

6A National Arab Bank (Al-Aziziyah Branch)	(5570932)	23H
7A National Commercial Bank (Al-Aziziyah Branch)	(5585609)	22J

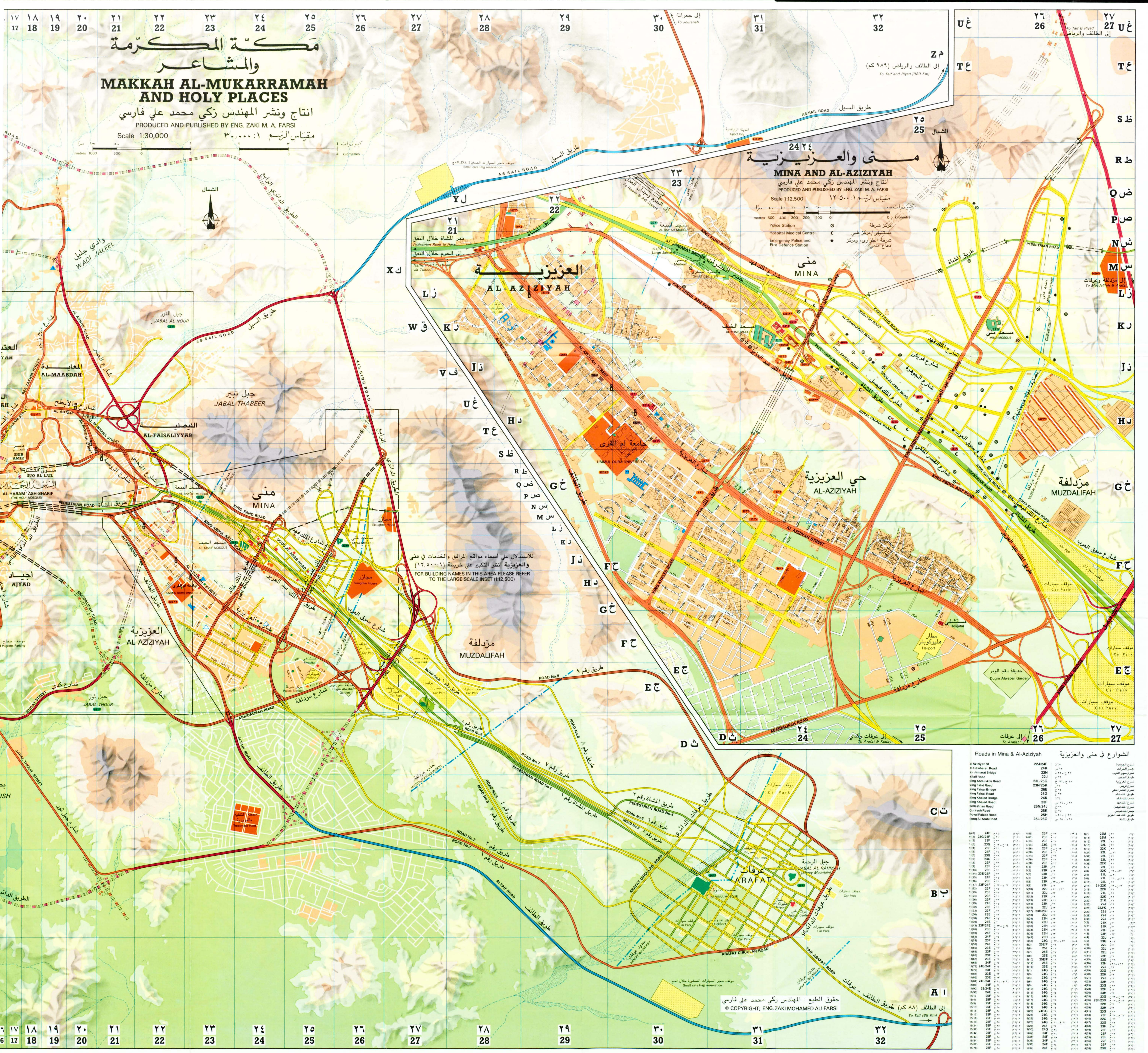


The grid reference system used in the index to locate a feature on the map is made up of numbers and letters. Numbers appear along the top and bottom of the map and apply to the areas between the vertical grid lines. Letters appear along each side of the map and apply to the areas between the horizontal grid lines. To locate a feature simply find the square formed by the intersection of the relevant grid lines. For example the centre of The Holy Mosque has a grid reference 14 N.

The reference system is common to all maps on both sides.

Legend — دليل

Expressway	طريق سريع
Arterial road	طريق رئيسي سريع
Main road	شارع رئيسي
Secondary road	شارع ثانوي
Pedestrian way	طريق مشاة
Tertiary road	طريق فرعي
Tunnel	نفق
Projected arterial road	طريق رئيسي سريع مقترح
Projected main road	طريق رئيسي مقترح
Projected secondary road	طريق ثانوي مقترح
Projected pedestrian way	طريق مشاة مقترح
Projected tertiary road	طريق فرعي مقترح
Projected tunnel	نفق مقترح
Car Park	موقف سيارات
Mosque/Historical Site	مسجد/موقع تاريخي
Public & Government Agency	مرافق حكومية وعامة
Hospital/Medical Centre/Pharmacy	مستشفى/مركز طبي/الصيدليات
Bank	مصرف - بنك
Petrol Station	محطات بنزين
Boys schools:	مدارس بنين
Elementary	ابتدائي
Preparatory (Intermediate)	اعدادي
Secondary (High)	ثانوي
Girls schools:	مدارس بنات
12th Elementary	الابتدائية الثانية عشرة
15th Preparatory (Intermediate)	الاعدادية الخامسة عشرة
3rd Secondary (High)	الثانوية الثالثة
Holy Area Boundary	حدود المشاعر
Built-up-area	منطقة معمورة
Land above 700 metres	أرض بارتفاع أكثر من ٧٠٠ متر
600-700 metres	٦٠٠ - ٧٠٠ متر
500-600 metres	٥٠٠ - ٦٠٠ متر
400-500 metres	٤٠٠ - ٥٠٠ متر
350-400 metres	٣٥٠ - ٤٠٠ متر
300-350 metres	٣٠٠ - ٣٥٠ متر
250-300 metres	٢٥٠ - ٣٠٠ متر
Land below 250 metres	أرض بمنسوب أقل من ٢٥٠ متر



Roads in Mina & Al-Aziziyah — الشوارع في منى والعزيزية

Al Aziziyah St	22J/24F	٢٥ ذ	شارع الجوهرة
Al-Gawharah Road	24K	٢٣ س	جسر الجمرات
Al- Jamarat Bridge	23N	٢٦ ج - ٢٥ ذ	شارع سوق العرب
Altaif Road	22J	٢٢ خ	طريق الطائف
King Abdul Aziz Road	23L/25G	٢٥ ج - ٢٣ خ	شارع العزيزية
King Fahd Road	23N/25K	٢٥ ر	شارع قريش
King Faisal Bridge	26E	٢٥ خ	شارع القصر الملكي
King Faisal Road	26G	٢٣ خ	طريق الملك خالد
King Khaled Bridge	24K	٢٤ ذ	جسر الملك خالد
King Khaled Road	23F	٢٥ ر - ٢٤ س	شارع الملك فهد
Pedestrian Road	26N/24J	٢٦ خ	شارع الملك فيصل
Quraysh Road	25K	٢٧ ج	جسر الملك فيصل
Royal Palace Road	25H	٢٦ ج - ٢٤ ذ	طريق الملك عبد العزيز
Souq Al-Arab Road	25J/26G	٢٥ د - ٢٥ س	طريق المشاة

9(42)	24F	٢٤ ج	(٤٢)٩	4(59)	23F	٢٣ ج	(٥٩)٤	1(7)	22M	٢٢ ز	(٧)١
11(1)	23G/24F	٢٤ ج	(١)١١	4(61)	23F	٢٣ ج	(٦١)٤	1(11)	22M	٢٢ ز	(١١)١
11(2)	23F	٢٣ خ	(٢)١١	4(63)	23F	٢٣ ج	(٦٣)٤	1(13)	22L	٢٢ ز	(١٣)١
11(3)	23G	٢٤ ج - ٢٣ ج	(٣)١١	4(64)	23G	٢٣ خ	(٦٤)٤	1(15)	22L	٢٢ ز	(١٥)١
11(4)	23F	٢٣ ج	(٤)١١	4(66)	23F	٢٣ خ - ج	(٦٦)٤	1(17)	22K	٢٢ ر	(١٧)١
11(5)	24F	٢٤ ج	(٥)١١	4(68)	23F	٢٣ خ	(٦٨)٤	1(24)	22L	٢٢ س	(٢٤)١
11(6)	23G	٢٣ خ	(٦)١١	4(74)	23F	٢٣ خ	(٧٤)٤	1(32)	22L	٢٢ ز	(٣٢)١
11(7)	23G	٢٣ ج	(٧)١١	4(76)	23F	٢٣ ج	(٧٦)٤	1(34)	22L	٢٢ ز	(٣٤)١
11(8)	23F	٢٣ ج	(٨)١١	4(80)	23F	٢٣ ج	(٨٠)٤	1(38)	22K	٢٢ ز	(٣٨)١
11(9)	23F	٢٣ ج	(٩)١١	5(3)	22K	٢٣ ر	(٣)٥	2(1)	22L	٢٢ ر	(١)٢
11(13)	23F	٢٣ ج	(١٣)١١	5(5)	23K	٢٣ ذ	(٥)٥	2(3)	22K	٢٢ ر - ٢٢ ذ	(٣)٢
11(14)	23E/23F	٢٣ ج	(١٤)١١	5(6)	23K	٢٣ ر	(٦)٥	2(4)	21L	٢١ س	(٤)٢
11(15)	24F	٢٤ ج	(١٥)١١	5(7)	23H	٢٣ د	(٧)٥	2(6)	21L	٢١ ر - ٢٢ س	(٦)٢
11(16)	23F	٢٣ ج	(١٦)١١	5(8)	23K	٢٣ ز - ٢٣ ر	(٨)٥	2(11)	22L	٢٢ ر	(١١)٢
11(17)	23F/24F	٢٤ ج - ٢٣ ج	(١٧)١١	5(9)	23H	٢٣ د	(٩)٥	2(14)	21-22K	٢٢ ز - ٢٢ ر	(١٤)٢
11(22)	23F	٢٤ خ	(٢٢)١١	5(10)	22J	٢٣ د - ٢٢ د	(١٠)٥	2(18)	22K	٢٢ ر	(١٨)٢
11(23)	23F	٢٣ ج	(٢٣)١١	5(11)	23J	٢٣ د	(١١)٥	2(19)	21L	٢٢ ر	(١٩)٢
11(24)	23F	٢٣ ج	(٢٤)١١	5(12)	23K	٢٣ ر	(١٢)٥	2(20)	22K	٢٢ ر	(٢٠)٢
11(26)	23F	٢٣ ج	(٢٦)١١	5(13)	23H	٢٣ ج	(١٣)٥	2(23)	21K	٢٢ ر	(٢٣)٢
11(29)	24F	٢٤ ج	(٢٩)١١	5(14)	23K	٢٣ ر	(١٤)٥	2(25)	22J	٢٢ د	(٢٥)٢
11(32)	23E	٢٣ ج	(٣٢)١١	5(15)	22J	٢٣ د	(١٥)٥	2(26)	22J/K	٢٢ ر	(٢٦)٢
11(33)	23F	٢٣ ج	(٣٣)١١	5(17)	23H/23J	٢٣ د	(١٧)٥	2(27)	22J	٢٢ د	(٢٧)٢
11(36)	23E	٢٣ ج	(٣٦)١١	5(18)	23J	٢٣ د	(١٨)٥	2(28)	22J	٢٢ د	(٢٨)٢
11(38)	24F	٢٤ ج	(٣٨)١١	5(24)	23H	٢٣ د	(٢٤)٥	2(30)	22J	٢٢ د	(٣٠)٢
11(39)	24E	٢ ج	(٣٩)١١	5(28)	23H	٢٣ د	(٢٨)٥	3(2)	21K	٢١ ر	(٢)٣
11(43)	23F/24E	٢٤ ج - ٢٣ ج	(٣٤)١١	5(30)	23H	٢٣ د	(٣٠)٥	3(11)	21K	٢١ ر	(١١)٣
11(46)	23E	٢٣ ج	(٤٦)١١	5(34)	23H	٢٣ د	(٣٤)٥	4(1)	23H	٢٣ د	(١)٤
11(50)	24F	٢٤ ج	(٥٠)١١	5(36)	23H	٢٣ د	(٣٦)٥	4(3)	23H	٢٣ د	(٣)٤
11(52)	24F	٢٤ ج	(٥٢)١١	5(42)	23H	٢٣ د	(٤٢)٥	4(4)	22J	٢٢ د	(٤)٤
11(53)	23F	٢٣ ج	(٥٣)١١	5(48)	23G	٢٣ د - ٢٣ خ	(٤٨)٥	4(5)	23G	٢٣ خ	(٥)٤
11(58)	24F	٢٣ ج	(٥٨)١١	8(3)	25E/F	٢٥ ج	(٣)٨	4(6)	22J	٢٢ د	(٦)٤
11(60)	23E	٢٣ ج	(٦٠)١١	8(6)	25F	٢٥ ج	(٦)٨	4(10)	22J	٢٢ د	(١٠)٤
11(63)	23F	٢١ ج	(٦٣)١١	8(7)	25E	٢٥ ج	(٧)٨	4(11)	22J	٢٢ د	(١١)٤
11(65)	23F	٢٣ ج	(٦٥)١١	8(8)	25E	٢٥ ج	(٨)٨	4(14)	22H	٢٢ ز	(١٤)٤
11(67)	23E	٢٣ ج	(٦٧)١١	8(10)	25E/F	٢٥ ج	(١٠)٨	4(15)	23G	٢٣ خ	(١٥)٤
11(68)	24F	٢٤ ج	(٦٨)١١	8(12)	25E	٢٥ ج	(١٢)٨	4(16)	22H	٢٢ د - ٢٢ د	(١٦)٤
11(78)	24E/24F	٢٤ ج	(٧٨)١١	8(16)	25E	٢٥ ج	(١٦)٨	4(17)	22J	٢٢ ر	(١٧)٤
11(79)	23F	٢٣ ج	(٧٩)١١	9(1)	24G	٢٤ خ	(١)٩	4(19)	23G	٢٣ خ	(١٩)٤
11(81)	23E	٢٣ ج	(٨١)١١	9(3)	24G	٢٤ خ	(٣)٩	4(20)	22H	٢٢ د	(٢٠)٤
11(83)	23E	٢٣ ج	(٨٣)١١	9(4)	23G	٢٣ خ	(٤)٩	4(21)	22J	٢٢ د	(٢١)٤
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15(1)	25F	٢٥ ج	(١)١٥	9(15)	24G	٢٤ خ	(١٥)٩	4(35)	23G	٢٣ خ - ٢٣ ج	(٣٥)٤
15(4)	25F	٢٥ ج	(٤)١٥	9(17)	24G	٢٤ خ	(١٧)٩	4(36)	23F/23G	٢٣ خ - ٢٣ ج	(٣٦)٤
15(5)	25F	٢٥ ج	(٥)١٥	9(18)	24G	٢٤ خ	(١٨)٩	4(37)	22H	٢٢ د	(٣٧)٤
15(13)	25F	٢٥ ج	(١٣)١٥	9(19)	24G	٢٤ خ	(١٩)٩	4(39)	22H	٢٢ د	(٣٩)٤
15(15)	25F	٢٥ ج	(١٥)١٥	9(20)	24F/G	٢٤ خ	(٢٠)٩	4(41)	23G	٢٣ خ	(٤١)٤
15(17)	25F	٢٥ ج	(١٧)١٥	9(21)	24G	٢٤ خ	(٢١)٩	4(43)	23F	٢٣ ج - ٢٣ خ	(٤٣)٤
15(18)	25F	٢٥ ج	(١٨)١٥	9(22)	24G	٢٤ خ	(٢٢)٩	4(45)	22G	٢٢ خ	(٤٥)٤
15(19)	25F	٢٥ ج	(١٩)١٥	9(25)	24G	٢٤ خ - ٢٤ ج	(٢٥)٩	4(47)	22G	٢٢ خ	(٤٧)٤
15(24)	25F	٢٥ ج	(٢٤)١٥	9(28)	24F	٢٤ خ	(٢٨)٩	4(48)	23H	٢٣ د	(٤٨)٤
15(32)	25F	٢٥ ج	(٣٢)١٥	9(30)	24G	٢٤ خ	(٣٠)٩	4(49)	23F	٢٣ ج	(٤٩)٤
15(42)	25F	٢٥ ج	(٤٢)١٥	9(32)	24F	٢٤ ج	(٣٢)٩	4(53)	23F	٢٣ ج	(٥٣)٤
15(43)	25F	٢٥ ج	(٤٣)١٥	9(34)	24F	٢٤ خ	(٣٤)٩	4(55)	23F	٢٣ ج	(٥٥)٤
15(54)	25F	٢٥ ج	(٥٤)١٥	9(36)	24F	٢٤ ج	(٣٦)٩	4(56)	22F	٢٣ ج	(٥٦)٤
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6 Eitabbiah Dispensary	(5740077)	11U
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9 Maabdah Dispensary	(5749411)	18U
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24 Abu Helal Pharmacy	(5453164)	6S
25 Alahly Pharmacy	(5731042)	17T
26 Al Asema (24 Hours) Pharmacy	(5742635)	16Q
27 Al Battarjee Pharmacy	(5421673)	14L
28 Al Haway Pharmacy	(5443603)	11U
29 Al Hekma Pharmacy	(5743970)	15R
30 Al Helal Pharmacy	(5433365)	13U
31 Al Jameel Pharmacy	(5445601)	6R
32 Al Kohol Pharmacy		9U
33 Al Madina Pharmacy		8K
34 Al Otiba Pharmacy	(5420465)	10U
35 Al-Saggaf Pharmacy	(5435832)	12T
36 Al Sawaf Pharmacy	(5428049)	14M
37 Al Shefaa Pharmacy	(5568604)	21N
38 Belal Pharmacy		8K
39 Fahmi Pharmacy	(5428059)	14L
40 Farook Jameel Khogair Pharm.	(5745842)	15Q
41 Granada Pharmacy	(5420345)	11U
42 Hanady Pharmacy	(5424267)	8Q
43 Hassan Bakhsh Pharmacy	(5742118)	15R
44 Hera Pharmacy	(5443075)	12K
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8 Al-Fateh Hotel	(5368700)	13M
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17 Al-Marzouki Hotel	(5731664)	14P
18 Al-Marzouki Hotel	(5733363)	13P
19 Al-Mufti Hotel	(5367676)	13N
21 Al-Qattan Hotel	(5744662)	15R
22 Al-Safa Hotel	(5744748)	13P
23 Al-Taiseer Hotel	(5365784)	17U
24 Badr Hotel	(5367928)	13L
25 Bahauddin Al-Falq	(5740307)	14R
26 Bahauddin Al-Mudda'a		15P
27 Bahauddin Al-Qararah	(5735558)	14P
28 Bahauddin Al-Shamiah	(5743224)	14P
29 Kutub Al-Din Hotel	(5744471)	13N
30 Makkah Hotel	(5747177)	13N
31 Shobra Hotel	(5427684)	14L
33 Zahrat Makkah Hotel	(5749522)	13N

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Abdullah Bin Az Zubayr St	14R
Abu Salasil Ln	17T
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Ajyad As Sud St	15M
Al Abtah St	19U
Al Andalus St	11U
Al Ashraf Ln	11G
Al Ashre Road	20W
Al Atar Ln	12H
Al Aziziyah Road	22L
Al Bashash Ln	11J
Al Boqari Ln	13Q & 12L
Al Bukhari Ln	12K
Al Dehan Ln	15R
Al Egabah St	18V
Al Falali Ln	12H
Al Fawwal Ln	12L
Al Gudaria St	15Q
Al Hafrah Ln	12N
Al Hajj St	9W
Al Hayetli Ln	12G
Al Hijra St	13K
Al Hujun St	10U-14T
Al Jabal Ln	14R
Al Jazair St	11U
Al Jazzar Ln	12J
Al Kasar Ln	14R
Al Khayat Ln	13J
Al Lasilki Ln	14R
Al Maghrabi Ln	13L
Al Malik St	13M-13N
Al Maliki Ln	14R
Al Mallah Ln	12P
Al Mansur St	8T-8K
Al Mansuriyyah St	6G
Al Maseeri Ln	12K
Al Masjid Al Haram St	15R
Al Misfalah St	13H
Al Munhana St	21T
Al Qala Ln	12M
Al Qarri Ln	11G
Al Raqubah St	15Q
Al Rasaifah St	6H-6R
Al Rashidi Ln	12P
Al Sowleetah Ln	11P
Al Sulaimaniyyah St	14S
Al Tahir Ln	22J
Al Taif Road	9T
Al Taneim St	9T
Al Under Qeeri Ln	14G
Al Raashidi Ln	12L
Al Rawdah St	20T
Al Ruwas Ln	12G
Arif Ln	13Q
As Sail Road	22V
As Subhani Ln	13J
Ash Shareef Hazza St	15R
Ba Jabir Ln	12K
Bab Al Omrah St	13N
Balselah Ln	12K
Basalaman Ln	12P
Batubarah Ln	12L
Bin Ladin St	9M
Bin Saleem Ln	11G
Dabloul Ln	12K
Daghistani Ln	13J
Fawaz Ln	11G
Hamzah Bin Abdul Muttalib St	12K
Hassan Bin Thabit St	9U
Ibn Khaldoun St	5P
Ibrahim Al Khalil St	11H-12L
Jabal Al Kaabah St	11R
Jabal Al Sudan St	16T
Jabal Thour St	13P
Jeddah St	7T
Jorhum St	9G
Khalid Ibn Al Walid St	11Q
Khandamah St	20W
King St	19E
Kuday St	19E
Madina-Makkah Road	8W
Matar Ln	13J
Mohammed Husain Ln	12L
Mominah St	15S
Mujahid Ln	14R
Muzdalifah Road	20H
Pedestrian Road	16N-21N
Qasr Al Diafah St	6U
Rea Zakhir St	18V
Shoab Abu Tabanjah	13J
Shobat Aal Kaushik	11H
Shobat Al Walayah	11J
Shobat Al Ramdani	12H
Shobat Sharaf	11H
Tabakha Ln	14R
Zainul Abedin St	12H
1st Ring Road	15L
2nd Ring Road	12S-14J-18L
3rd Ring Road	6F-14W

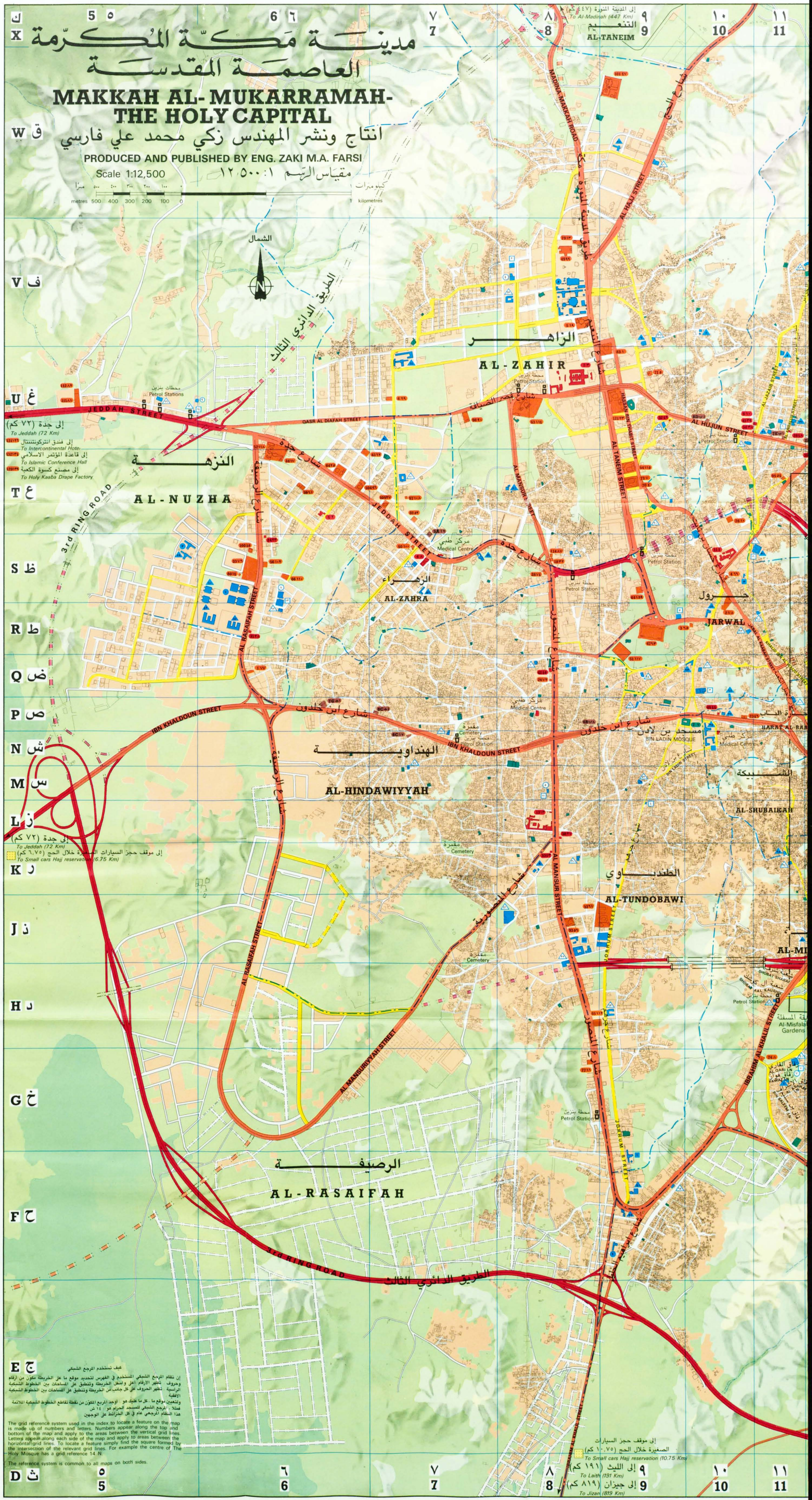
Roads in Mina & Al-Aziziyah الشوارع في منى والعزيزية

4(41)	23G	2(27)	22J	1(7)	22M
4(43)	23G	2(28)	22J	1(11)	22M
4(45)	22G	2(30)	22J	1(13)	22L
4(47)	22G	3(2)	21K	1(15)	22L
4(49)	23F	3(11)	21K	1(17)	22K
4(53)	22G	4(1)	22J	1(24)	22L
4(56)	22F	4(3)	22J	1(32)	22L
4(61)	23F	4(4)	22J	1(34)	22L
4(63)	23F	4(6)	22J	1(38)	22K
4(74)	23F	4(10)	22J	2(1)	22L
5(3)	22K	4(11)	22J	2(3)	22K
5(5)	22K	4(14)	22H	2(4)	21L
5(6)	23K	4(16)	22H	2(6)	21L
5(8)	23K	4(17)	22J	2(11)	22L
5(10)	22J	4(20)	22H	2(14)	22K
5(11)	22K	4(21)	22J	2(18)	22K
5(12)	23K	4(22)	22H	2(19)	21L
5(14)	23K	4(28)	22H	2(20)	22K
5(15)	22J	4(30)	23H	2(23)	21K
5(17)	22J	4(37)	22H	2(25)	22J
5(24)	23H	4(39)	22H	2(26)	22J

Legend دليل

Arterial road	طريق رئيسي سريع
Main road	شارع رئيسي
Secondary road	شارع ثانوي
Pedestrian way	طريق مشاة
Tertiary road	طريق فرعي
Tunnel	نفق
Projected arterial road	طريق رئيسي سريع مقترح
Projected main road	طريق رئيسي مقترح
Projected secondary road	طريق ثانوي مقترح
Projected tertiary road	طريق فرعي مقترح
Projected tunnel	نفق مقترح
Car Park	موقف سيارات
Mosque/Historical Site	مسجد/موقع تاريخي
Public & Government Agency	مرافق حكومية وعامة
Hospital/Medical Centre/Pharmacy	مستشفى/مركز طبي/الصيدليات
Hotel	فندق
Bank	مصرف - بنك
Petrol Station	محطات بنزين
Boys schools:	مدارس بنين
Elementary	ابتدائي
Preparatory (Intermediate)	اعدادي
Secondary (High)	ثانوي
Girls schools:	مدارس بنات
12th Elementary	الابتدائية الثانية عشرة
15th Preparatory (Intermediate)	الاعدادية الخامسة عشرة
3rd Secondary (High)	الثانوية الثالثة
Section Area Boundary	حدود الاحياء
Built-up-area	منطقة معمورة

Land above 700 metres	أرض بارتفاع أكثر من ٧٠٠ متر
600-700 metres	٦٠٠ - ٧٠٠ متر
500-600 metres	٥٠٠ - ٦٠٠ متر
400-500 metres	٤٠٠ - ٥٠٠ متر
350-400 metres	٣٥٠ - ٤٠٠ متر
300-350 metres	٣٠٠ - ٣٥٠ متر
250-300 metres	٢٥٠ - ٣٠٠ متر
Land below 250 metres	أرض بمنسوب أقل من ٢٥٠ متر




AL-TANEIM
To Al-Madinah (447 Km)
JABAL AL NOUR
جبل النور
To Taif and Riyadh (989 Km)
To Small cars Hajj reservation (6.75 Km)
AL-UTAIBIYYAH
العتيبية
AL-MAABDAH
المعابدة
AL EGABAH MOSQUE
مسجد الاجابة
AL-GEMMEZAH
الجميزة
AL ABTAH STREET
AL HIJRUN STREET
الفيصلية
AL-FAISALIYYAH
AS SAIL ROAD
طريق السيل
Concrete drain
Cemetery
مقبرة
AL-SULAIMANIYYAH
SHIB AMIR
2nd RING ROAD
JARWAL
جرول
Petrol Station
SUQ AL-LAIL
سوق الليل
AL-NAQA
AL-QARARAH
MINA
منى
PEDESTRIAN ROAD
AL-AZIZIYAH
العزيزية
BIN LADIN MOSQUE
HARAT AL-BAB
AL-SHUBAIKAH
الشبيكة
AL-TUNDOBAWI
الطندباوي
AL-MISFALAH
المسفلة
AJYAD
اجياد
Al-Misfalah Gardens
AL TAIF ROAD
AL AZIZIYAH STREET
UMMUL QURA UNIVERSITY
جامعة أم القرى
للاستدلال على أسماء مواقع المرافق والخدمات في هذه المنطقة انظر في التكبير على خريطة (١ : ٤٥٠٠)
FOR NAMES IN THIS AREA PLEASE REFER TO THE LARGE SCALE INSERT (1:4,500)
MUZDALIFAH ROAD
شارع مزدلفة
للاستدلال على أسماء المواقع والشوارع داخل المنطقة انظر الوجه الآخر
SEE OTHER SIDE FOR COMPLETE MAP OF MINA AND AL-AZIZIYAH
To Taif (88 Km)
To Small cars Hajj reservation (12.25 Km)
موقف حجاج البر
Land Pilgrims Parking
Land Pilgrims Parking
موقف حجاج البر
THOUR STREET
جبل ثور
JABAL THOUR
To Small cars Hajj reservation (10.75 Km)
To Laith (191 Km)
To Jizan (819 Km)
Petrol Station
حقوق الطبع : المهندس زكي محمد علي فارسي
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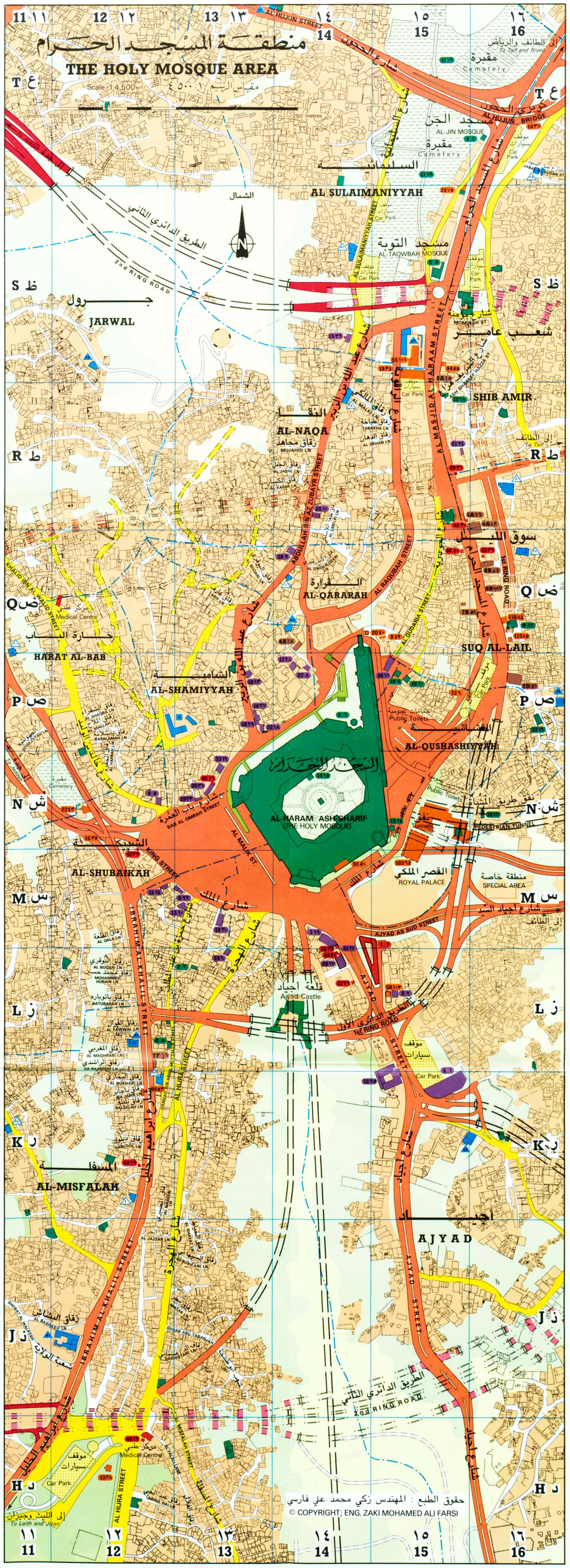
CARTOGRAPHY BY: CLYDE SURVEYS LTD., Reform Road, Maidenhead, ENGLAND.


منطقة المسجد الحرام
THE HOLY MOSQUE AREA
Scale 1:4,500
الشمال
AL-JIN MOSQUE
مسجد الجن
Cemetery
مقبرة
السليمانية
AL SULAIMANIYYAH
AL-TAQWABAH MOSQUE
مسجد التوبة
الطريق الدائري الثاني
2nd RING ROAD
JARWAL
جرول
شعب عامر
SHIB AMIR
النقا
AL-NAQA
سوق الليل
AL-QARARAH
القرارة
HARAT AL-BAB
حارة الباب
SUQ AL-LAIL
الشامية
AL-SHAMIYYAH
Public Toilets
AL-QUSHASHIYYAH
المسجد الحرام
AL-HARAM ASH-SHARIF (THE HOLY MOSQUE)
الشبيكة
AL-SHUBAIKAH
القصر الملكي
ROYAL PALACE
منطقة خاصة
SPECIAL AREA
AJYAD AS SUD STREET
قلعة اجياد
Ajyad Castle
Car Park
AL-MISFALAH
المسفلة
AJYAD
اجياد
AJYAD STREET
Car Park
AL HIJRA STREET
حقوق الطبع : المهندس زكي محمد علي فارسي
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